



**PEOPLE, PLANET AND PROFIT:
Peaceful Bed Fellows at the Best of Times But Strange
Roommates at Present - The Economist's Approach to a
Peaceful and Sustainable Co-Existence**

**BAYERO UNIVERSITY KANO
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SUMMARY OF PRESENTER'S BIODATA

Professor Mustapha Muktar is an Economist with specialization in Environmental Economics, Mathematical Economics, Applied Statistics and Health Economics. He teaches at the Department of Economics, Bayero University, Kano. He has supervised many Bachelor of Science (BSc.), Master of Science (MSc.) and (PhD) students in Economics and has also supervised three PhD in Public Health from Texila American University, Guyana as well as a PhD in Economics from University of Colombo, Sri-Lanka. Mustapha has also served as external examiner to many MSc. and PhD students at the Nigerian Defence Academy, Kaduna.

He is member of the Editorial Board of many journals both in Bayero University and other institutions. He has served as Editor-in-Chief, Bayero Journal of Social and Management Sciences (BAJOSAM). He is a member of many professional associations such as the African Society of Ecological Economics, Association of Financial Analysts of Nigeria AFN, International Research and Development Institute, and Business Ethics Network, Africa. He has participated as resource person in many state and national development projects. To date, Mustapha has attended many national and international conferences with corresponding paper presentations.

Born at *Kurawa*, Kano Municipal Local Government Area on 24th April 1974. Professor Mustapha obtained his BSc. and MSc. Economics in 1997 and 2001 respectively and obtained PhD in Economics in 2008. He started working with Bayero University in 2000 and he was promoted to the rank of professor in 2016. Mustapha has authored, co-authored and edited many books including: *Introduction to Mathematics for Economists*, *Readings in Economics*, *Studies in the State of the Nigerian Economy*, *Introduction to Mathematics for Social Sciences*, *Quantitative Techniques in Social and Management Sciences*, *Nigerian Social Problems* and a monograph titled: "Solid Waste Recycling, Employment and Income Generation in Developing Countries - The Case of Plastics Waste in Kano, Nigeria". Mustapha served in various departmental, faculty and university positions. He was the Head, Department of Economics, Bayero University Kano 2014 - 2016, Head, Department of Economics Umar Musa Yar'adua University, Katsina 2011 - 2013, Sub –Dean, Faculty of Social and Management Sciences, 2008 – 2010, Deputy Director in Charge of Strategic Planning, 2012 – 2014 and has served in several committees. He has contributed several articles in both national and international journals. Professor Mustapha Muktar is married and blessed with children.

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INTRODUCTION

The primary objective of man-environment research is to fully understand their relationship with a view to arriving at sustainable use of environmental assets in the course of economic decisions and the maintenance of balance among them, thereby bringing the damage done to the environment to a halt, at the same time creating and consuming economic goods and services. Man in the course of satisfying his economic needs have utilized the natural environment and in some cases, his activities are damaging as for every efforts to satisfy his wants, the natural environment is degraded to a certain limit. A lot of environmental problems ranging from desertification, water pollution, air pollution, deforestation, solid wastes, toxic waste and climate change can partly be attributed to the production and consumption of economic goods as well as the creation of profits either in monetary terms or otherwise. Under ideal condition, economic development is supposed to lead to improvement in welfare through the provision of wide range of goods and services as well as broadening consumers' choice and improving individual utilities. However the above is only possible if a harmony exists between people, planet and profits.

Environmental problems created due to man's activities in his search for survival includes industrialization, siting industrial enclaves, adverse effects of energy sources their exploitations synthesis and utilization, agriculture and its practices, global warming, climate change as well as poverty and food insecurity which are spillover effects of disequilibrium between people planet and profits. The presence of these problems necessitates the need for empirical researches in order to formulate feasible policies that are necessary for sustained economic growth and development as well as better and sustainable environmental management.

Solid wastes are one of the most damaging and visible environmental problems especially in the developing world where they are not well managed. It based on this that various researches were done in Kano State to contribute to effective and efficient waste management. Emphasis was made on resource recovery, reuse and recycling due to their importance in employment and income generation as well as alleviation of

raw material shortages to industries. In all the researches undertaken policy recommendations were formulated.

As part of the economist's approach to solving the identified problems, studies were undertaken on poverty alleviation, food insecurity and health economics specifically economic evaluation of healthcare-based programmes, projects and or interventions using mainly the Cost Analysis to provide policy signals/recommendations to policy maker especially at the level of public health.

The interaction between man, environment and the economy has evolved along with humanity. As populations grow around the world and as large industrialized or industrializing countries continue to exploit the planet's natural resources, the relationship changes, and mostly for the worse. Natural resources are essential inputs for production in any economy, while production and consumption also lead to pollution and other pressures on the environment. Poor environmental quality in turn affects the economy and well-being by lowering the quantity and quality of resources or due to health impacts.

The environment becomes one of the major concerns to the present economy because of the activities of man. The relationships between man and environment have been changing along the development process from generation to generation. Economists are concerned with increasing demand for resources and its implications on the natural environment, therefore, a controversy on the limits to growth. The environment provides food shelter, clothing, medicine, raw materials and other resources. Economics is concerned with making best allocation of resources among competing alternatives; it is concerned with utilization of resources to ensure an improvement in welfare. There is therefore, a strong link between humanity, environment and economy, humanity are faced with a lot of environmental problems which have economic dimensions.

This lecture therefore, examines the interrelationships between man environment and economy; it is also concerned with how damage done by man to the environment can come to a halt or reversed.

The evolution and process of human civilization is a story of man in his struggles against nature, man has to subject nature to satisfy his wants because he needs basic necessities of life, and in his attempt to satisfy them, he not only conquers the

immediate environment but jeopardizes the future of the next generation to come. This interrelationship is presented by Fig 1;

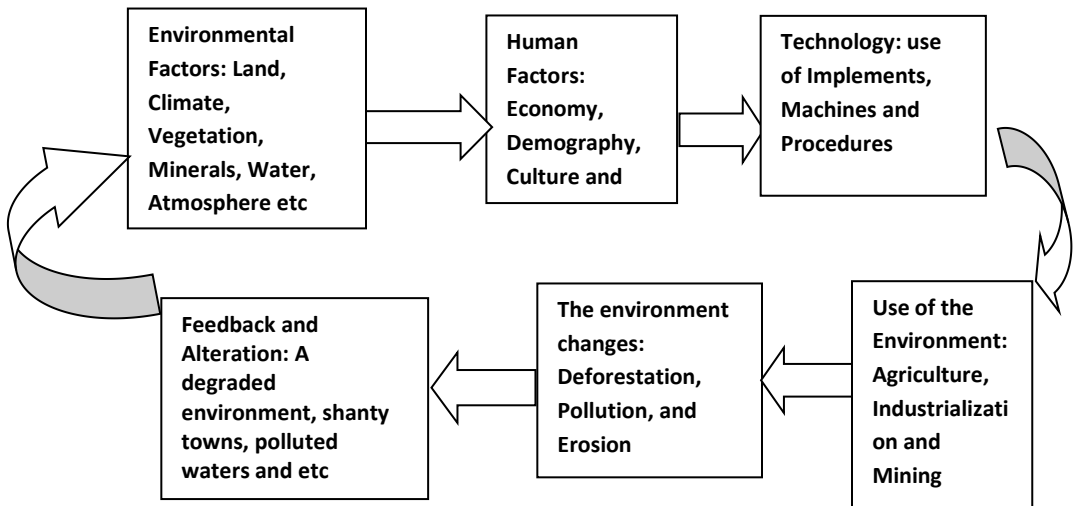


Fig 1: *Relationship between man, environment and economy*

Man Environment and Economy

From Figure 1, it can be seen how the environment provides land, climate, forests, water bodies and other assets. Human factors in form of demography, culture and economy uses technology machines and procedures to decide on how to use the assets provided by the environment through agricultural practices, industrialization, mining and other income-generating activities all in an effort to make profits. The process of creating profits results to environmental pollution, bad agricultural practices like bush burning, deforestation and application of chemicals by fisherman to have greater catches which results to a degraded environment in form of shanty towns, polluted waters, deforested land and leached soils and generally an altered planet which in turn, becomes the present environment that we live in.

The interdependence among man environment and the economy is nowadays not balanced as the natural environment is at the mercy of the economy and human beings are behind the economic activities, the different consumption inputs such as air, water, recreational facilities, are provided by the environment however, water that was used

for the production of energy (cooling systems for electricity), carbon monoxide emitted by our cars, or maybe domestic waste that is daily produced by the households and the industries negatively affects the environment.

The residuals dumped into the environment are received by the different constituents of the environment: atmosphere, soil and water. They are partly disintegrated, accumulated, carried to other places or changed in structure. The diffusion function explains this process as it maps residuals' emission into concentration of pollutants, i.e. noxious agents that exert a negative influence on the environment. This influence may show up as an adverse effect either on the characteristics of the inputs for consumption processes e.g. exposure to noise by an airline; contamination of drinking water by the industrial disposal of toxic agents, acids, etc. Pollutants' concentration is mapped into social (money-valued) damages by means of a damage function. The causing of damages indicates that the environment has been degraded.

ENVIRONMENTAL POLLUTION

Pollution is the release by man of substances, chemicals and other products into the environment that adversely affects life and properties. It can also be a consequence of natural disasters; for example, hurricanes often involve water contamination, oil spills or the release of hazardous materials into the environment. The substances that are released into the environment are termed pollutants. Pollutants can cause disease including cancer, allergies, asthma etc. Pollution can take various forms depending on the nature of the pollutant and the damage it causes to the environment. We can therefore identify pollution to include that of air, water, land, thermal and noise pollution.

Economics of Pollution

Pollution developed from the concept of externalities, an externality is a situation whereby the activity of an economic agent say A enters directly or indirectly into the utility function of another agent say B, such that $Utility\ of\ B = f(A)$. Pollutants result from a production or consumption process in which the conversion of inputs into outputs is not efficient in a physical sense, that is some of the inputs become waste products. Residuals from economic process enter into the environment and damage it. The extent of this damage however, depends on the absorptive capacity of the natural environment. Whenever the residuals outweigh the absorptive capacity of the environment then, pollution occurs.

Economic Activities and Environmental Pollution

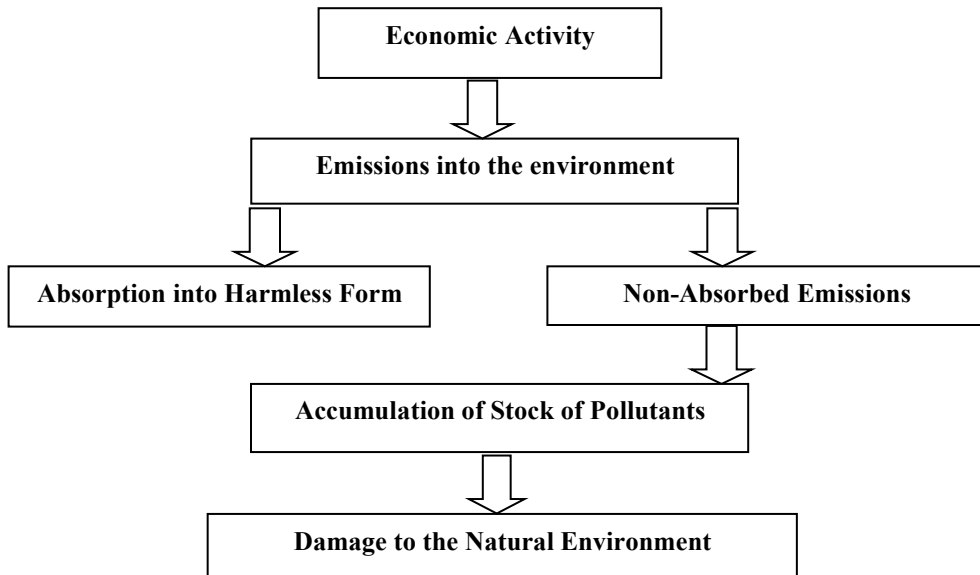


Fig 2: *Pollution flow from economic activities*

Economists are concerned with the effects of pollution on welfare and are therefore interested in the damage done to the environment as a whole. Pollution, from economic perspective, can be defined as the net flows exceeding the absorptive capacity of the environment and which have damaging effects upon human welfare and the ecological system in general. Pollution affects the magnitude and size of environmental resources. For example, it affects the growth of plants, animals, as well as the quality of physical assets. It can also affect the quality of air, land, water and other environmental assets that exist in the environment.

Efficient Level of Pollution

Identifying efficient levels of pollution is very crucial in pollution abatement and control. Existing technology cannot produce goods and services without pollution and hence, a trade-off between production and pollution exists as undesirable things (pollution) are created. The argument can be summarized as:

Net Benefits of Pollution = Benefits of Outputs Associated With Pollution Minus Damages Resulting from Pollution

Since pollution occur as a by-product of economic activities that satisfy wants, then the satisfaction has a set of wants that can be expressed in terms of environmental

goods that are forgone, balancing the benefits associated with environmental and other outputs will determine the amount of pollution that is created. Economists regard environmental problems like pollution as too important to be left to environmentalist and scientists alone and therefore are preoccupied with finding a sustainable solution.

Pollution Control from the Scientific Point of View

Scientists, since time immemorial, have been making efforts to control pollution from technical aspects, that is, by trying to reduce emissions through design of products and structures that emit less pollutants. Other procedures include recycling the pollutants to harmless substances, or using the end products in other processes. In the case of wastewater, recycling into a harmless substance is done while solid wastes are either incinerated or composted. In the case of pollutants that enter into air bodies, one of the approaches is the adoption of cyclone separators.

The Case of Cyclone Separators for Air Pollution Control

Emissions of particulate pollution in flue gases may be reduced using a cyclone separator. The cyclone works by directing the stream of flue gases around a conical cylinder (see Figure 3). Centrifugal acceleration draws the heavier particles to the outside of the cylinder, from where they will settle to the bottom and be extracted. Clean gas is extracted from the top, at the centre of the cylinder. The effect is like amplifying and speeding up gravitational settling, not requiring the large area and long residence times of a settling chamber. The cleaning efficiency of the device depends on the particle size and the rotational velocity achieved. Larger, heavier particles will 'settle' to the outside wall more readily than smaller ones, due to their higher terminal velocities. Turbulence prevents very fine particles from settling, in the same way that larger stones and sand settled in a fast flowing river more readily than fine mud and clay (Smith, 2001).

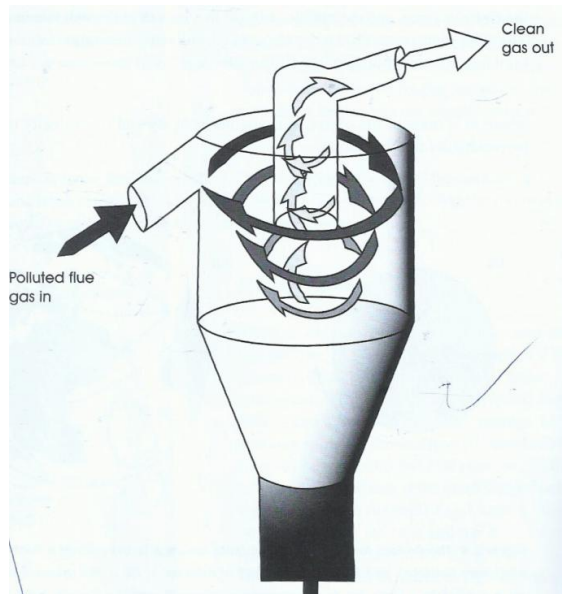


Fig 3: *A cyclone separator*

Economic Instruments and Pollution Control

The economic approach to pollution control is designed to produce the maximum pollution reduction for a given expenditure. The key benefit of economic instruments is that they would allow a given pollution target to be met for lower overall cost than traditional regulations a considerable advantage given the perceived high financial burden of regulatory compliance. There are other benefits too. Economic instruments grant firms and individuals greater autonomy to decide how to meet targets; they create ongoing incentives for firms to design new and improved abatement technologies ensuring that pollution control becomes ever cheaper; they reduce the information burden on regulators; and they provide potential revenue sources for state or federal governments. In addition, economic instruments may provide greater flexibility in dealing with smaller and diffuse emissions sources which collectively contribute large amounts of pollution, but which until now have been largely ignored in favour of controlling the pollution from more obvious sources.

Emission Standards ES

This is a legal approach in which the authorities impose emission standards on each source, in economics; this approach is referred to as “command-and-control approach.” An emission standard is a legal limit on the amount of pollutant an individual source is allowed to emit; failure to abide attracts charges. From an

economic point of view, emission standards are set taking into account the efficient pollution levels, where total costs of reduction equals to total benefits of reduction would lead to too much control of pollution from an efficiency point of view. This approach is however practised mainly in developed and organized societies where monitoring of emissions is possible.

Transferable Emission Permits TEP

Under this system, all sources are required to have permits to emit. Each permit specifies how much a firm is allowed to emit and the permits are freely transferable and can be bought or sold and any source exceeding the permit will cause severe monetary sanctions. This programme begins with a centralized decision on the total number of discharge permits to be put into circulation. These permits are then distributed among the sources responsible for the emissions. Some formula must be used to determine how many permits each source will receive. In a transferable emission permit system a new type of property right is created. This property right consists of a permit to emit pollutants. Each permit (also known as an *allowance*) entitles its holder to emit one unit (kilogram, tonne, or however the permit is calibrated) of the waste material specified in the right. Rights holders would ordinarily have a number of such permits at any point in time.

Economists would advocate using social efficiency (where marginal damages equal marginal abatement costs) as the criterion for determining the total number of permits chosen. How the actual bargaining process takes place will depend on the number of traders and other factors. The essential point is that as long as marginal abatement costs are unequal among these sources, they can both become better off by trading permits at some price between these marginal abatement costs. Thus, in the trading of permits and the adjusting of emissions in accordance with their permit holdings, these sources would be led to an outcome that satisfies the equi-marginal principle.

Product Charges/Taxes PC

Where it is not possible to monitor the level of emissions, then the commodity that is most directly responsible for pollution/emissions should be taxed. For example gasoline could be taxed rather than the emissions, also fertilizer is taxed rather than the contamination it did to the ground water sources. Product charges, fees or taxes are prices paid for discharges of pollutants to the environment, based on the quantity and/or quality of the pollutant(s). To be most effective the charge is levied directly on the quantity of pollution ('emissions tax or charge'), though if this is difficult to measure or monitor, it may be necessary to levy a charge on a proxy for the emissions,

typically on the resource that causes the pollution ('product tax or charge'). Product charges occur at different usage points. They have been levied on products either as they are manufactured. The Irish have even tax plastic bags to prevent littering; one limitation of this is that products are taxed uniformly while they caused different level of emissions. The Irish Bag Policy of 2002 results in a tax of \$15 per plastic bag and it brought about 95% reduction in bags and revenue was generated (see <http://www.Golby.edu/~thtieten/litter.html/>). In countries like Nigeria this is possible as the products that are responsible for emission can be taxed.

Subsidies and Concessions SC

Where taxes or charges can be used as a penalty on discharges, subsidies can be used to reward the reduction of discharges in a similar manner. The financial incentive is effectively the same, though the flow of funds is in a different direction. A subsidy programme will involve a transfer of funds from the government to the industry, while a charge programme would be a revenue source for the government. Subsidies may be relatively explicit in the form of grants and soft loans, or be somewhat indirect, such as in adjusted depreciation schedules. Subsidies are negative taxes that can be used to reduce pollution; they are negative *pigovian* taxes as they change the rational decision of firms' cost benefit analysis. To reduce pollution, the marginal benefit of reducing the next unit is increased. Here marginal cost equals to marginal benefit at a higher abatement level that is lower pollution level as the subsidy serves as additional benefit to the firm. Sometimes subsidy can be in form of tax concessions that reduces firm's tax liability by a certain proportion. The firms that enjoyed subsidy will have to internalize externality they produce and it is further rewarded if the pollution level is reduced to acceptable range.

INDUSTRIALIZATION, ENERGY AND ENVIRONMENT

As society expands and become complex the need for various sources/types of energy to support both domestic and industrial activities also expands. Industrialization is associated with the utilization of one form of energy or another, since it converts raw materials into finished goods. Extraction of mineral resources that yield energy is associated with environmental degradation. This can be in the form of health risks, acid leached into streams from mine operations as well as air pollution due to burning of fossil fuels. In most cases, the environmental damage is not borne by the owner and hence not compensated and as such, is not part of the extraction decisions of the energy source.

Industrialization has brought economic prosperity. Additionally, it has resulted in more population, urbanization, obvious stress on the basic life supporting systems while pushing the environmental impacts closer to the threshold limits of tolerance. With booming industrial growth and relatively low land mass, environmental sustainability is now becoming a significant deciding factor in industrial development process. Industrialization has resulted in global environmental degradation. The developing world is often seen as having a high percentage of heavily polluting activities within its industrial sector. This has led to extreme pressures on the environment and impoverished the population by destroying the natural resource base.



Fig 4: *Air pollution from industrialization*

Industrial processes play a major role in the degradation of the global environment. In industrialized countries, environmental regulation and new technologies are reducing the environmental impact per unit produced, but industrial activities and growing demand are still putting pressures on the environment and its assets. The more developed a country's industrial capacity, the greater the potential for economic growth and development.



Fig 5: *Waste water from a tannery*

Mining and Environment

In areas where minerals are extracted for energy purposes, the environment changes and the change relates to the way and manner the energy sources are being extracted. The extraction of energy source may be in form of open cast, quarrying, or deep cast, in case of oil and natural gas, it is deep drilling.

Mining of mineral/energy resources causes considerable environmental changes as sometimes it is many kilometres deep and wide. It creates ponds and pits that accelerate erosion rates, disrupts local drainage networks and since it cannot support vegetation cover, then it paves way for desertification and desert encroachment especially when it happens in savannah regions.



Fig 6: *Mining area in Plateau State, Nigeria*

Another environmental impact is that a lot of villages have to be relocated for the mining activity to take place and hence farmlands as well as other ecological assets will be lost forever. The relocation of people will ultimately lead to migration to urban areas, increase urban population and the loss of scenic value as well as recreational facilities. Sometimes cave-ins and other accidents can occur causing a lot of people to lose their lives. Cave-ins do occur in working and abandoned mines.

Hydroelectric Energy and Environment

Hydroelectric energy is renewable because it is an energy resource that regenerates in a short time period. It is made by generators that are pushed by movement of water. It is usually created with dams that block a river to make a reservoir or collect water that is pumped there. When the water is released, the pressure behind the dam forces the water down pipes to turn turbines and generate electric currents. Later the energy is tapped, transmitted, stored and subsequently distributed.

Electric and magnetic fields have been suggested as being harmful to humans, with concerns being voiced over a hypothesized link with childhood leukemia in children living near to overhead transmission lines. Anecdotal evidence also exists of increased headaches, fatigue, nosebleeds, and more serious complaints including immune system disorders and cancers. Electrical fields from high voltage transmission lines are high compared with other sources (such as household equipment), and change rapidly with the alternating current. It has been suggested that these could disrupt the

electrical activity in the body in some way. However no evidence has been found to prove this conclusively, despite a number of studies. Electrical fields do not penetrate the body significantly as our bodies conduct electricity, an external electric field would be conducted away harmlessly in our skin as with any other conductor. Magnetic fields are still an issue, with rapidly varying fields above $0.2 \mu\text{T}$ considered potentially damaging although again, the evidence does not show any significant link (Day et al. 1999).

One possible mechanism is via the field's effect on airborne pollution in the form of aerosols. High electric fields polarize water droplets in the air, which will then be attracted by the cables, resulting in an elevated level of aerosol droplets around the cables. Meanwhile pollutant molecules such as sulphur dioxide, nitrogen oxides, and organics can become ionized by striking the power lines. These ions then dissolve in the water droplets, and may then be inhaled by people living or working near the power line. It is believed that pollutants in this charged form may be more readily absorbed, through the lungs, than those in a gaseous or non-ionic form. The droplets may also contain bacteria, viruses, particulates, and radioactive pollutants such as radon. Hence, it is possible that the health effects observed may be caused by air pollution, indirectly increased by the existence of the power line; however research is ongoing in this area. (Smith, 2011).

Biomass Energy and Environment

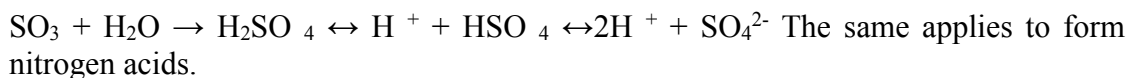
A more disastrous effect of energy on the environment is seen from the pollution generated in the course of utilizing the energy source. It results to destruction of soil, aquatic and atmospheric quality. The use of fossil fuels is of most significance here. The inputs of these energy sources are being accelerated when they are used in industrial process. The mining of coal as well as radioactive elements for energy purposes have succeeded in polluting groundwater as well as damaging both the flora and fauna. The use of fossil fuels began with industrial relocation, concern was mainly on the increase in concentration of *chloro-fluoro* carbons and greenhouse gasses which affects the climate. The deposition of the gasses is one of the most causes of aquatic and terrestrial acidification, it has also rendered water supply importable. These gasses may also pose threats to human health which includes lead pollution from automobiles and industrial process.

Stored carbon from biomass and fossils is rapidly being transformed to atmosphere. Increasing concentration of CO_2 into atmosphere due to emission of unburned hydrocarbons could damage plants health and hence negatively affect productivity and

can also lead to global warming. The release of gasses into the atmosphere as a result of industrialization may also lead to acidification as precipitation because it is more acidic and hence lead to decline in fish stock and other water resources. Acid rains occur and it corrodes paints and destroys structures. The formation of acid rain can be demonstrated below:



As sulphurous acid can be oxidized by various oxidants. Oxidant $\text{SO}_2 \rightarrow \text{SO}_3$ and can therefore form a weak sulphuric acid as below:



Biomass energy in the form of fuelwood to supply human needs has been used since the first cavemen sat around their cooking fire, and is still the largest renewable energy form used in the world today. In some developing countries, fuelwood and other biomass energy such as straw, stalks and dung, used as the main fuels for cooking and heating, provide most of national primary energy use. Wood is also widely used across the world, particularly in rural areas, while the production of energy from wastes and fuel crops is increasing. While biomass fuels produce CO_2 in combustion, the amount produced is equivalent to that used in photosynthesis when they grow, and so they have the potential to form a sustainable, carbon-neutral energy resource. There are many other environmental issues to consider, including emissions such as particulates and NO_x , hazardous emissions including dioxins from incineration of certain wastes, and land use in energy crops. However it is now widely recognized that biomass could provide a valuable and cost-effective energy resource with much lower environmental impact than fossil fuel.

The energy content of biomass fuels is generally lower than their fossil fuel counterparts, as shown in Table 1. This is one factor that limits their value, together with their being more bulky, often heterogeneous in nature, and having high water content. This makes them more expensive to transport and store, and less convenient to use, although new technologies can overcome these difficulties. Biomass energy use is increasing in the world in many new forms, using various organic wastes to produce electricity or heat, and collecting gas from landfill sites.

Table 1: *Energy content of some biomass fuel*

Fuel	Typical Energy Content, MJ kg⁻¹
Wood (air dry)	15
Dung	15
Straw (depending on crop)	13-18
Coconut and groundnut shells, olive pits	20
Domestic refuse, unsorted	9
Paper and card	17
Industrial wastes (depending on industry)	7-20
Fossil Fuels for Comparison	
Coal	29
Petroleum	42
Natural Gas	55

Source: Hall et al. (1982)

Nuclear Energy and Environment

Other environmental problems occur with the cracking and utilization of radioactive material/elements to speed of the energy requirement of industrial process. Two major environmental problems are nuclear accidents and storage of radioactive wastes. In the course of energy production, radioactive elements releases waste to the environment inform of heat and toxic substances that damaged the environment, where these accidents do not occur, the management and storage of the waste is another problem as it is not easy to end the nuclear cycle for example, uranium once used contain thorium 230 which decays with half life of 78, 000 years to a Radon 222. Also strontium-90 and cesium-137 decayed after approximately 1,000 years as such once used today they affect not only the current generation but the succeeding ones.

Electronic e-waste is a serious environmental problem, from toxic chemicals and heavy metals leaching into soils in landfills, to the pollution of air and water supplies caused through improper recycling techniques. While we know e-waste is harmful to human health, particularly to those working directly with it in e-waste dumps, new research sheds light on exactly how it impacts us. Studies found that it affects human lungs. The e-waste pollution in air, close to waste dumps causes inflammation and stress that lead to heart disease, DNA damage and possibly even cancer. Other

negative impacts of nuclear and electronic wastes includes thyroid damage in pregnant women it can cause miscarriage, stillbirths, and other complications.

Ionizing radiation has enough energy to ionize atoms of any substance it encounters. If radiation enters the body, it can cause chemical damage to cells or to DNA, which can cause cancer. In large doses, radiation sickness is produced, caused by large-scale cell damage leading to sickness and sometimes death within days or weeks. In the longer term, damage can include both production of many different cancers, including leukemia and genetic mutation affecting future children of the exposed person; cancers may appear years after exposure, the long delay is partly because radioactive material can become lodged in the body, where it stays for many years gradually decaying and releasing energy and α - or β -radiation which does the damage. Where organs such as the liver concentrate particular elements, specific problems can occur. Thyroid cancer produced by iodine - 131 ingestion is a particular concern as iodine is absorbed and concentrated by the thyroid gland. The risk can be reduced by consumption of iodine tablets containing the stable isotope, which is accumulated in the thyroid causing the radioiodine to be excreted, but only if consumed before significant exposure. (Smith, 2011).

Consideration of the pathways by which radiation can enter our bodies reveals factors that create greater variations in individual doses. While gamma rays and neutrons can enter directly by exposure to radiation, other forms cannot penetrate the skin. Gases such as radon and dust may be inhaled and soluble material taken in from water. Radioactive material may enter the food chain and be eaten in meat, milk, fish or vegetable matter, or as dust or dirt consumed with food, particularly by children.

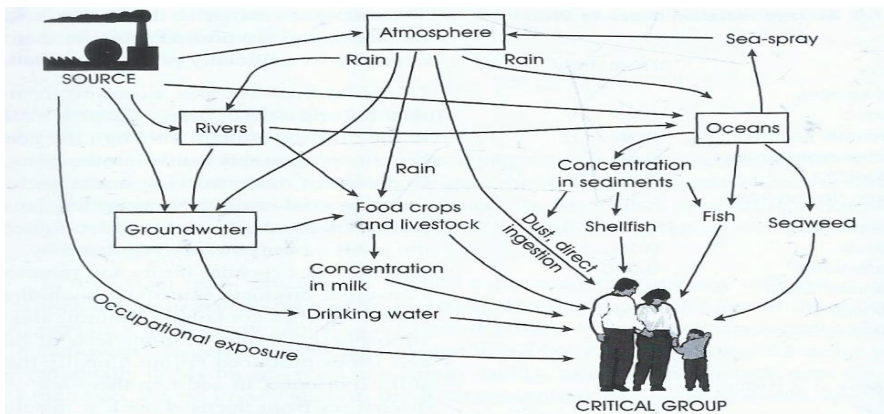


Fig 7: Environmental pathways for uptake of radioisotopes

The pathways available to a particular radionuclide depend upon its physical and chemical properties. Of particular concern are radioisotopes that may mimic important nutrients. For instance, strontium 90 has similar chemical properties to calcium. It can be taken up into milk via the diet of a cow, and then when drunk, absorbed by the body as a calcium substitute and incorporated into bones and teeth, particularly in children.

While many environmental processes act to dilute and disperse pollutants, in some cases natural processes can lead to concentration and bioaccumulation. Once in the soil or water, many radionuclides will not be taken up by plants or seaweed to any great extent, but some will be selectively absorbed leading to high concentration in the plant. Ocean currents may carry concentrated pollutant bodies some distance before dispersal occurs, and sedimentation processes can in some cases lead to concentration. Shellfish and marine plants such as seaweeds can selectively uptake certain nutrients, such as iodine and phosphorus. If this seaweed is eaten either directly or by fish that then are consumed by humans, large doses may be received. The amounts of any particular radionuclide reaching humans will be greater by some pathways than others, due to the many possible routes it could take. The pathway that provides the greatest dose to a particular population is termed the critical pathway (Smith, 2011).

Heat Energy and Environment

Thermal pollution occurs if there is sudden increase or decrease in temperature of a natural body of water which may be ocean, lake, river or pond by human influence. This normally occurs when a plant or facility takes in water from a natural resource and puts it back with an altered temperature. Usually, these facilities use it as a cooling method for their machinery or to help better produce their products. Firms that produce different products or wastewater facilities are often the cause of this massive exodus of thermal pollution. Causes of thermal pollution include the use of water as cooling agents, deforestation, erosion and other adverse environmental practices. Negative effects of thermal pollution include loss of aquatic diversity, species extinction, and increase in toxins, migration and host of others

Solar Energy and Environment

Solar energy and photovoltaic are best known as a method for generating electric power by using solar cells to convert energy from the sun into a flow of electrons by the photovoltaic effect. Solar cells produce direct current electricity from sunlight which can be used to power equipment or to recharge a battery. Solar cells convert sunlight directly into electricity. Solar panels are made of semiconducting

materials similar to those used in computer chips. When sunlight is absorbed by these materials, the solar energy knocks electrons loose from their atoms, allowing the electrons to flow through the material to produce electricity. This process of converting light (photons) to electricity (voltage) is called the photovoltaic (PV) effect. This form of energy though renewable is associated with negative effects on the environment as the solar panels may consume space where there is scarcity of land than this is more pronounced, the energy is also stored in batteries and the used batteries may be hazardous and negatively affects the environment.

Entropy and the Environment

In a philosophical way, many of our environmental problems are characterized by large increases in entropy in the natural environment. It is because these changes are irreversible that our society is unsustainable. We extract natural resources to produce goods, and when they are worn out we throw them away and start again. We don't commonly re-use those resources, which are now dispersed through landfill sites or incineration. These are high entropy systems that would require high energy input to reclaim the materials. In the process we rely on the throughput of large amounts of non-renewable energy.

In many ways, mankind's interaction with Earth is to turn a highly complex, diverse system (low entropy) into a much simpler degraded environment (high entropy) in a way that is essentially irreversible due to the increases in entropy taking place. The natural systems are sustainable because they are reliant only on the energy from the Sun to maintain their low entropy, while we have increased the energy throughput by using fossil fuels. In the process we are creating our own very complex physical and social environment which has low entropy, but is dependent upon these energy flows, and on degradation of natural systems (Smith, 2011).

Table 2: *Environmental issues and entropy*

Low Entropy State	Higher Entropy State
Fossil energy resources in concentrated form underground	Energy degraded to heat; resources to CO ₂ and dispersed through the atmosphere
Minerals and metals in concentrated form underground	Minerals and metals dispersed through mine waste and final disposal of goods after consumption, energy used in processing
Land covered by highly diverse ecosystems with many species	Much land in monoculture agriculture sustained by high energy input, many species extinct
Surface waters kept pure by balanced biological and physical systems	Rivers and oceans polluted by low concentrations of many toxic substances
Soils developed over a long time, containing a balanced community of animal, plant and bacterial life	Soils reduced by pesticides/herbicides to an inorganic substrate needing energy-intensive artificial fertilizers to be productive, or damaged by erosion.

Source: Adopted from Smith, 2011

Overall therefore, entropy is increasing much faster. Much of environmental awareness is about recognizing this process, and making value judgements about whether what we are destroying is a price worth paying for the material world we are creating.

AGRICULTURE AND ENVIRONMENT

Agriculture is the science and art of tilling the soil and rearing of animals for the purposes of producing food for man and raw materials for industries. Population growth and the need for foreign exchange have stimulated agricultural practices and development and hence this prompted environmental change. The impact of agricultural practices on the environment is dependent on the type of the natural environment (whether desert, rainforest, or mountain region) and the form of agricultural practice. Some of the negative effects of agriculture on the environment are deforestation, soil erosion, salinization, bush burning and overgrazing.

Deforestation is the removal of vegetation cover and the consequences manifests itself in several forms such as erosion, drought, firewood scarcity, sedimentation and micro-

climatic damages; deforestation is caused by indiscriminate felling of trees and large scale extraction of wood for furniture as well as paper and pulp manufacturing. The developing world deforests over a million hectares per year. Some consequences of deforestation are species extinction, loss of fixed carbon and reduced capacity of water retention by soils.

Soil erosion is a situation whereby top soils are removed or lost from land surface it can be caused by crude agricultural practices such as bush burning, deforestation and overgrazing. The soil is the top layer of the earth's surface. It is made up of dirt and rock. It is filled with air and life. A variety of organisms, like insects, earthworm, live in soil. For plants, soil serves as a storehouse of water and minerals needed for their growth. It also provides shelter to many animals that live on or in the soil. Without soil, there would be no grass, no crops, no trees, no food for us and other animals. Erosion leads to removal of soil and loss of its qualities which in turn leads to low agricultural productivity as the soil becomes infertile.

Salinization is a form of environmental degradation associated with irrigation which leads to reduction in crop productivity. Salinization connotes an increase in the concentration of minerals due to inadequate drainage, and the groundwater becomes saline and water logged the area, the affected land therefore becomes unsuitable for production, since the presence of salt and minerals in the roots of crops hinders their growth. Salinity also increased due to high water loss where evaporation is rapid. Salinity greatly affects crop production, depending on the level of salinity and the tolerance limit at the critical stage of the growth of a particular crop. It restricts cultivation of many crops leading to changes in land use patterns with increasing salinity in surface and groundwater, access to freshwater becomes scarcer, and that, in turn, affects economic and household activities. Salinity does not only decreases the agricultural production of most crops, but also, effects soil physicochemical properties, and ecological balance of the area its negative impacts further include low economic returns and soil erosions.

Bush Burning: In developing world especially, fire is used to clear virgin lands for agricultural purposes. Fire has been listed as a major threatening process for biodiversity. Frequent burning of bush is generally considered to have negative effects on biodiversity as fire can change plant communities by reducing dominance of some plants while enhancing the dominance of others. Uncontrolled burning causes loss of nutrients like nitrogen, sulphur and carbon, elimination of seedlings to grow, destruction of humus as well as adverse effects on soil micro-fauna and destruction of

micro-flora. All of the above have adverse effects on the environment and results to low productivity in agriculture.



Fig 8: *Bush burning for agricultural purposes*

Overgrazing: This is over exploitation of the grazing lands usually by herdsmen and farmers. It triggers soil erosion, desertification and other process of environmental degradation. Productivity is diminished with a consequence on economy and the welfare of people. Fertility of land will also decline since its botanical composition has changed as more palatable and nutritious species are removed. Most of the causes of overgrazing are man-made. Man-made overgrazing usually happens when herdsmen become irresponsible, refuse to treat the land with the respect that it deserves and allowing their livestock to roam unchecked. Having too many animals on a small piece of land will undoubtedly lead to overgrazing.

Control of Adverse Agricultural Practices on Environment

Deforestation can be controlled by an effective forest policy, afforestation programmes and tree planting campaigns. Policies should however be continuous and sustainable. Soil erosion can be converted by counter ploughing, mixed and inter-cropping, establishment of vegetation cover, adoption of suitable land use measures and measures of early detection so as to deter its occurrence. Salinization can however be reversed by creating canals, to allow free passage of water and by appropriate agricultural practices. Bush burning can be converted first, by the introduction of leguminous plants to help conserve soils nutrients by enhancing the process of nitrogen build-up in the soil, and secondly by promulgating a law to stop it. Lastly, overgrazing can be controlled by legislation through collaborating with the local

people and all stakeholders involved limiting their action on frequent and heavy grazing of lands.

GLOBAL WARMING AND CLIMATE CHANGE

The phenomenon of global warming has attracted and generated a lot of arguments within the academic and environmental cycles. It is simply an increase in the atmospheric temperature and its effects on the environment. Global warming has impacted the average global temperature and by extension, it affects sea level and other environmental indices. It results to hotter days in the tropics as well as heavy storms. Environmentalists and scientists have linked it to the activities of man (as they are associated with the release of chlorofluorocarbons, methane, oxides of carbon and nitrites etc.). Global warming is therefore is linked to climate change.

Understanding the economy in its ecological context (and also, in fact, in its social context) is an idea that has not received much attention until recently; the idea of common wealth. It now appears that an important part of the common wealth of all humanity is the global atmospheric capacity to absorb greenhouse gasses without disastrous climate effects. Until the industrial revolution this capacity was never noticed, as it was in a balance in which greenhouse gasses emitted such CO₂ in the decay or burning of trees and plants, and by other natural causes, were offset, principally by new plant growth and by the carbon uptake of the oceans. The major source of CO₂ emissions is, as is well known, the combustion of fossil fuels, while deforestation also releases (and reduces the capture of CO₂)

Ozone Layer Depletion

The ozone in the stratosphere acts to protect us from harmful ultraviolet (UV) radiation from the sun, which it absorbs. A small reduction in ozone concentrations can lead to large increases in the amount of harmful UV reaching Earth, specifically, around wavelengths of 295—300 nm. Excessive UV exposure can cause skin cancers, and in large amounts can also be harmful to plant growth. The highest risks are in spring at extreme southerly latitudes or to a lesser extent at extreme northerly latitudes, corresponding to the formation of ozone holes over Antarctic and Arctic Polar Regions. Ozone (O₃) forms from oxygen (O₂) by a reaction under the influence of UV radiation. Short wavelength radiation, of wavelengths 175 nm or less, has sufficient energy to dissociate oxygen into two separate free oxygen atoms. This occurs at heights of 50 km or more, and results in very little radiation less than this wavelength penetrating further. The free O atom can then combine with an O₂ molecule to form ozone. Ozone forms in this way above tropical and equatorial regions where solar radiation is highest, and spreads around the globe to form a thin layer at between 20

and 26km in height. The ozone layer, if expressed at standard temperature and pressure would only be 3mm thick, yet it absorbs strongly enough in the UV region to act as an almost complete shield against radiation of wavelengths less than around 295 nm (Smith, 2011).

The most important greenhouse gas that we emit is carbon dioxide (CO₂), but there are a number of greenhouse gases other than CO₂, a greenhouse warming potential (GWP) is defined. This is used to convert the concentration into ‘CO₂-equivalents’, i.e. the amount of CO₂ emitted that would have the same effect on warming as 1 tonne of methane, CFCs etc. Because the gases have different lifetimes in the atmosphere, their greenhouse warming potentials depend on the time span over which they are measured. Note that CO₂ is a relatively weak greenhouse gas, but is the most important because it is emitted in such vast quantities. By contrast CFCs are thousands of times stronger in their warming effect, but they are not emitted in such high quantities (Smith, 2011).

Table 3: Properties of the Main Greenhouse Gases

	Carbon dioxide	Methane	CFCs and HCFCs	Nitrous oxide
Contribution to GH warming	55%	15%	24%	6%
Concentration: Pre-industrial	280 ppm	0.8 ppm	0	288 ppb
Current	359 ppm	1.7 ppm	800 ppt	310 ppb
Increase p.a	0.5%	0.9%	4%	0.25%
Lifetime, years	50-200	10	50-150	150
GWP: 20 y	1	63	4,000-7,000	270
100 y	1	21	1,500-7,300	290
Sources	Fossil fuels, deforestation, cement making	Agriculture, gas leaks termites	Propellants, refrigerants, fire, extinguishers, agricultural chemicals	Combustion

Note: ppm= parts per million; ppb = parts per billion; ppt=parts trillion, all by volume

Source: Adapted from Smith, 2011

Greenhouse Warming, Feedbacks and Climate Impacts

In order to estimate the impacts of global warming, it is necessary to follow the effects of a greenhouse gas through from its emission to the final climatic changes, as illustrated in Figure 9. The first step is to estimate emissions. This is relatively straightforward for CO₂ from energy use, but more difficult for some of the other sources and greenhouse gases.

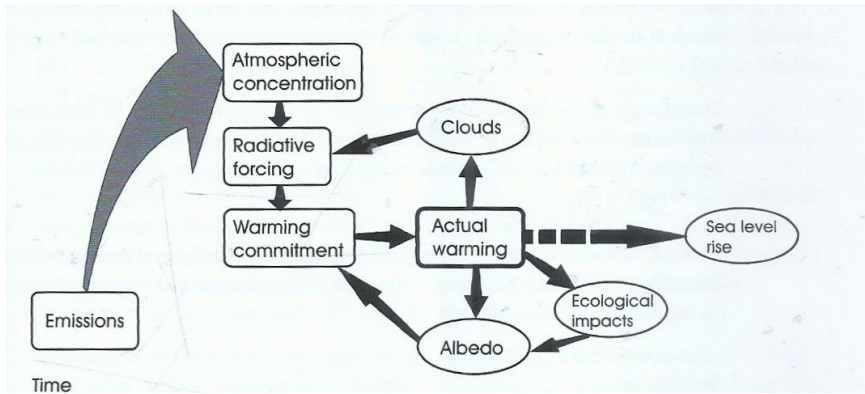


Fig 9: *Stages in greenhouse warming*

Once emissions have been quantified, the impact on atmospheric concentration is determined from knowledge of the cycling of the gas in the biosphere. This is not known accurately, but can be estimated from historical records of emissions and concentrations. For carbon dioxide, approximately half of all emissions are rapidly taken up into sinks such as forests and plankton, with the rest increasing the atmospheric concentration. Over a long period (around 200 years), if CO₂ emissions stopped altogether, these sinks would gradually absorb all the excess pre-industrial level. These changes depend on the carbon cycle, an important biogeochemical cycle that describes the flows and sinks of carbon, determining how much is in the atmosphere (Smith, 2011).

Of particular concern is the massive destruction of rain forests in tropical countries, which not only releases carbon that had been stored in living trees it also reduces the uptake of carbon from the forest biota, both above ground and in the soils. While part of the reason for this destruction can be traced to population growth, with growing demand for land on which to grow food, a larger amount relates to development and

trading patterns in which tropical forests are cut down to sell the wood abroad, or to grow crops.

Climate change is the change in the state of climate that can be identified by changes in the mean or variability of its properties that persists for extended periods, usually decades or longer. Rapid industrialization is associated with emissions into the atmosphere, these emissions deplete the ozone layer and the result is rise in temperature.

The United Nations Environmental Programme (UNEP) established an Inter-governmental Panel on Climate Change (IPCC) to examine the issue and make recommendations. In 2001, an assessment report was concluded and several conclusions were reached since then, they include:

- i. That the average temperature of the earth has increased from (0.3°C - 0.6°C) in the past 100 years. 1998 was the warmest followed by 2005 and 2002.
- ii. That sea level have risen 10 – 12cm.
- iii. A strong correlation between increase in temperature and concentration of green house gasses
- iv. Human activities have greatly increased the concentration of green house gasses

Consequences of Climate Change on the environment and the economy

- i. Rising sea level which increase floods and disrupts navigation, it erodes beaches and other areas near the seas and oceans.
- ii. It disrupts the hydrological cycle (some places are wetter while some are be drier).
- iii. At extremely high temperature there is increase in the number of people who die of one sickness or another, so it has health effects and as labour force falls sick there will be loss of man hour and loss of output as well.
- iv. It changes the natural vegetation types as some species of plants and animals will die due to changes in temperature and other environmental factors associated with climate change.
- v. Agriculture and food security will be negatively affected; crop yield will be adversely affected. Hotter climate means increase in irrigation demand and where there exist flood means agricultural output will be destroyed.
- vi. There will be increase in risks as well as increase in demand for insurance as the number of diseases will increase so also an increase in crop insurance and other agents to be insured.

- vii. Migration will increase as places affected by floods and extreme temperatures are likely to be evacuated and people will migrate to safer areas.
- viii. Poverty incidence will also increase due to manifestation of food insecurity, loss in agricultural output, floods and other dangers.
- ix. Other unanticipated changes, these are risks that are yet to be identified (just as the Antarctic ozone hole became a surprise), therefore a variety of troubles and possibilities were hypothesized. They include more frequent and severe storms, shifts in ocean currents, submerging of settlements and a massive reduction in crop yields.

Addressing /Controlling Climate Change

- i. Improving energy efficiency and by extension, reduction in the emission of green house gasses. Taxes can be placed on units of gasses released into the environment by both individuals and corporate bodies. The tax can be achieved either through the command and control approach, product charges, subsidies or any suitable and relevant instrument.
- ii. Improving vegetation cover so that the CO₂ can be converted by plants during photosynthesis thereby reducing the impact of CO₂ released by burning fossil fuels (this is however a short-term measure).
- iii. Political and economic forces as international agreements were reached and are expected to cause a sharp reduction in the volume of chlorofluorocarbons released as a result of economic activities.

Adopting to Climate Change

Adopting means coping with those climate change effects that we cannot, or will not prevent. The greatest need is to help vulnerable communities and individuals (in both rich and poor countries) to increase their ability to cope with climate-related catastrophes. Two social characteristics, in particular, are increasingly being perceived as essential for adaptation. One is resilience, which means, among other things, that the least advantaged groups in society must be strengthened, and supportive institutions developed, so that in the face of catastrophes they can adapt instead of being crushed.

The other requirement for successful adaptation and a prerequisite for resilience is social cohesion, which means that people identify with larger social goals than their own immediate interest. Among the things that are most damaging to social cohesion are wide inequalities. Income and wealth inequality in most developing and developed

countries are at about their high-water mark for the last hundred years; inequality is also exceptionally high, by recent standards, in many other parts of the world. Efforts towards a fair distribution of income and resources are therefore needed for adaptation to climate change.

POVERTY AND ENVIRONMENT

Poverty is viewed as deprivation of basic needs. It is the inability of an individual to access, afford, sustain and utilize the basic necessities of life (food, clothing, shelter, education, security and information). Analysis of the relationship between environment and poverty nexus starts with a review of analytical relationships of poverty and environmental conditions, including an account of the impact of environmental degradation on poor people. It then moves on to deconstruct some specific environment-poverty myths. It also re-examines some of the conventional wisdom on the environment, growth and poverty nexus.

The relationships between environment and poverty are a two-way relationship. Environment affects poverty situations in three distinct dimensions: by providing sources of livelihoods to poor people, by affecting their health and by influencing their vulnerability. On the other hand, poverty also affects environment in various ways: by forcing poor people to degrade the environment, by encouraging countries to promote economic growth at the expense of environment, and by inducing societies to downgrade environmental concerns, including failing to channel resources to address such concerns. Environment matters a lot to poor people. Their well-being is strongly related to the environment in terms of, among other things, health, earning capacity, security, physical surroundings, energy services and decent housing.

In rural areas, poor people may be particularly concerned with their access to and control over natural resources, especially in relation to food security. For poor people in urban areas, access to a clean environment may be a priority. Prioritization of environmental issues may vary across different social groups. For example, poor women, reflecting their primary role in managing the household, may regard safe water, sanitation facilities, and abundant energy services as crucial aspects of well-being for poor people.

Some aspects of environmental degradation reflects truly global concerns, such as global warming and the depletion of the ozone layer. Some are international, like acid rain, the state of the oceans, or the condition of rivers that run through several countries. Some are more localized, though it may often occur worldwide, like urban

air pollution, water pollution, or soil degradation. Even though poor people also feel the impact of global environmental degradation, it is local environmental damage that affects the lives of poor people more. The impact of environmental degradation is unequal between the poor and the rich. Environmental damage almost always hits poor people the hardest. Across the world, it is poor people who generally live nearest to dirty factories, busy roads and dangerous waste dumps.



Fig 10: *Poor people living in slum with their animals*

The loss of biodiversity is most severe for poor rural communities. Environmental degradation, by depleting the health and natural support systems of poor people, may make them even more vulnerable.

Poverty and Human Health

Poverty is one of the major causes of ill health and a barrier to accessing healthcare as well. The poor cannot afford to purchase those things that are needed for good health, including sufficient quantities of quality food and healthcare. The poor are deprived of some necessities such as information on appropriate health-promoting practices or of voice needed to make social services work for them. Poverty creates hunger which in turn leaves people vulnerable to diseases. Poverty denies people access to reliable and affordable health services. It denies people access to preventive care, for example it denies poor children access to immunization against some diseases.

Poverty creates illiteracy which eventually makes people less informed about health risks. It forces people to live in environments that make them susceptible to certain diseases. One of the barriers to healthcare for the poor is the time it takes to get treatment. Time is a resource since the time taken away from work may mean lost income. Ill health, in turn, is a major cause of poverty. This is partly due to the costs of seeking healthcare, which include not only out-of-pocket spending on care (such as consultations, laboratory tests and drugs), but also transportation costs and any other indirect medical and non-medical cost. Poor families coping with illness might be forced to sell their assets to cover medical expenses, borrow at high interest rates or become indebted to the community.

RESEARCHES ON WASTE MANAGEMENT, FOOD INSECURITY, POVERTY AND HEALTH ECONOMICS

In 2004 a research titled: “The Need for a More Integrated Approach to Solid Waste Management in Kano” was carried out with the aim of assessing the solid waste management strategies as well as the feasibility for a more integrated approach.

Integrated solid waste management refers to the strategic approach to sustainable management of solid wastes covering all sources and all aspects of generation, segregation, transfer, sorting, treatment, recovery and disposal in an integrated manner, with an emphasis on maximizing resourcefulness and efficiency. The problem of solid waste is the direct result of growing urban population, the changing pattern of production and consumption, the inherently more urbanized lifestyle and the consequent industrialization in the state. The increasing amount of waste from residential areas has affected the quality of the environment and results in diseases such as typhoid fever and cholera. Drainages and roads were blocked by the waste and the entire environment degraded.

Field observations and interviews were conducted on 120 sampled respondents across metropolitan Kano. Some of the findings were that the solid waste in metropolitan Kano was mainly organic and inorganic and therefore composting may be an option for the organic waste while the inorganic can be landfilled or recovered, by and large food scraps constitutes most of the organic waste while the inorganic constitutes metal scraps, plastics waste, glass and others which have the potential of being reused. The existence of peri-urban agricultural practices is a pulling factor to the compost as there

is the need for organic fertilizer, the recycling firms and the need for recovered materials necessitates the need for resource recovery from the waste generated.

One important finding is the calorific value or the energy that is likely to be generated from the solid waste that is if incinerated and tapped. The average low caloric value was estimated to be about 5.2mj/kg. The recovered energy can be used to supplement the deficit in the energy requirement of the state, the benefits are two folds, first the environment is cleansed and secondly, energy is recovered. (Mustapha, 2004).

Landfills are another management options, the prevalence of many burrow pits and ponds which were spillover effects of roads and residential constructions have necessitated the dumping of wastes inside especially the construction and demolition debris. However, the landfills are open dumps and are not in accordance with global specifications on safety. The recovery of the ponds and landfills, if well organized, could be beneficial too.

The recommendations emanating from this research is that the state government should design an integrated waste management master plan and coordinate the various waste management options in accordance to the global best practices, these techniques if coordinated can be income generating and at the same time environmentally friendly, organic fertilizer could be provided, jobs will be created, raw materials will be available and balance will be struck among people, planet and profits.

The economic impact of solid waste scavenging in Kano, Nigeria was examined in 2006. Sixty sampled scavengers were interviewed and their responses were analysed. Since in most urban areas the population is so high such that it exceeds the productive capacity of the cities, unemployment is thus inevitable, and that leads to poverty as most of the unemployed appear to be dependants with little or no income. The prevalence of poverty leads to environmental degradation in form of indiscriminate dumping of waste materials, poor drainage system, air pollution and even deforestation. Goodall (1972) observed a cyclical relationship between urbanization, unemployment, poverty and environmental degradation. He argued that the poor degrades the environment more than the rich and as a result of urbanization immigrants and poor people have over-utilized the natural resources and sometimes even resorted to such activities that do not require any skill or capital like informal waste recovery(scavenging) so as to supplement their incomes and earn a living. It is against this background that the research was aimed at examining the economic impact of scavenging in metropolitan Kano.

Out of the total number of 60 scavengers interviewed 54 are males while only 6 are females. Since respondents are selected at random, it can be deduced that scavenging in Kano state is not equally divided between males and females, this account for bias in favour of males. The bias may perhaps be due to the culture and religion that is prevailing in the study area which restrict females especially married women from coming out to scavenge for useful materials. The above figure also showed that 75% of the respondents are 30 years old or younger. Of this young workforce 30% of the sample was children of 15 years or less. The drop-out rate from the workforce particularly is pronounced at the age of 45. An explanation for this phenomenon may be that, scavenging is a profession that requires young and energetic people who can walk the length and breadth of the city to search for useful materials. No female scavenger was recorded from the age of 15 years or less.

The illiteracy rate among the respondents was 70%. Only 18 scavengers had some knowledge of formal education and they are all primary school drop-outs between classes 2 – 5, therefore, we can conclude that scavenging in Kano state is practised mainly by those with no formal education. Another important finding is the dominance of immigrants from villages in the profession. All the 60 scavengers interviewed are however, Muslims and this may be due to the location of the study area.

The various reasons that attracted the people into scavenging according to findings are, 38% of the sampled scavengers are into the activity for the income and employment it provides; 27% joined scavenging due to poverty while 20% is due to their low social status which includes lack of shelter, education orientation and parental care. The last category practised scavenging due to personal interest, by chance and some of them say they don't know the reason. 65% are into scavenging because of economic reasons (poverty, income and employment). Majority of the waste pickers lived with their families and contributed to household income. It was observed that young children usually accompanied their mothers from an early age.

Major type of materials recovered by scavengers are plastics, metals, glass bottles and others. The materials categorized under others were identified to be old car batteries, used grain bags, papers, rags, wood, and so on. The sources of these materials are mainly two; open dumps that are considered to be no man's land and households. In case of materials from the households a token amount is being given in exchange for a recyclable material, sometimes new plastic plate, matches box, are given to the household members in exchange.

27% of sampled scavengers worked for 4 – 6 hours, while 53% worked for 6 – 12 hours. It can be concluded therefore, that more than half of the scavengers worked for the whole day. It was observed that on the average, scavengers worked between the hours of 8am to 6pm that is 10 hours in a day.

The average quantity of waste materials collected by a scavenger in a day was estimated to be 15kg. The average daily income of a scavenger was estimated to be N400; it was also observed that male scavengers earn more than their female counterparts. Finally it was discovered that in some cases, scavengers recovered materials and used it personally, these materials include fire wood and clothes. It should be noted that the items that are recovered and used for personal consumption by scavengers are not included in the estimation of scavengers' total earnings.

A strong relationship was however observed between area of operation and earnings of scavengers. In higher income areas like the government reserve areas (GRA) scavengers find more useful materials in dumps, this is due to the fact that households located in higher income areas do not care to collect useful materials from their waste before discharge. Their consumption pattern and nature of the products consumed is another contributing factor. These findings suggest that scavenging is an unorganized activity that requires little or no skill. An estimated monthly income of a scavenger as at 2005 was found to be equal to N12000. The monthly income is however above the minimum wage paid by the state civil service. Among the problems facing scavengers in the state is the issue of multiple taxes levied on them by both the local governments and the state Ministry of Environment

It is recommended that scavengers should form cooperatives so that they can pool their efforts and resources together and bargain collectively, Government and non-governmental organizations should therefore enlighten them through seminars, and campaigns. Scavenger cooperatives have been practised in Latin American countries and have succeeded.

In 2010, the role of scavengers in solid waste recycling process in Nigerian cities was investigated as most Nigerian cities have faced challenges in the management of solid waste as increased urbanization and population explosion have combined with inadequate basic infrastructure of urban services to result in increased generation and poor disposal of solid waste. Poverty and unemployment have necessitated human scavenging. The activities of scavengers have helped in resource reuse and recovery, however despite these roles; they operated in an informal setting or the grey economy.

The study is documentary in nature and it examined the roles played by scavengers in major cities of the country. First, it has been observed that open dumps that are not frequently evacuated by the relevant authorities dominate most Nigerian cities like Lagos, Kano, Ibadan, Ilorin Warri, Port Harcourt, Maiduguri, Sokoto, Jos, Lokoja and others.



Fig 11: *Scavengers at a dump site*

It was discovered that in Nigerian cities, scavengers are both males and females. Their respective roles however include collection, separation, and storage, upgrading and compacting. The scavengers have good knowledge of the kind of waste they are interested in collecting which includes plastics, iron, and bottles, copper, used containers and iron/steel. Among the problems they face is harassment from law enforcement agents, vulnerability to diseases, low bargaining power, and the non-integration of their activities into the formal waste management cycle. It is recommended that integration of scavenging into the formal economy by respective governments will help in reaping its full benefits.

The youth and waste scavenging: implications for socio-economic and health hazards was the next research undertaken in 2010. Unemployed youths engage in activities that earn income for their survival and that of their families. Youths have now begun to ravage dustbins, owing to the economic downturn of the country and thus, they have certainly begun to earn their means of livelihood from the dustbin. The poor

economy and government's unfavourable policies have compelled the youths to find alternative means of survival. Scavenging refuse dumps with the hope of finding scraps of metals, aluminium, rubber and plastics which they could fabricate or sell out in order for them to make ends meet and also to enhance their relevance in the society is one of the solutions they have adopted. It has become a common scene in Kano State to see youths carrying sacks and sticks while they roam garbage dumps. They use sticks for scavenging for any hidden treasure beneath the trash and any identified material, no matter how dirty, is quickly stored away in their sacks.



Fig 12: *A youth scavenger sorting materials at a dump site*

Youths, who have been scavenging refuse dumps for long, claimed ownership of specific refuse dumps especially those located in highbrow areas, thereby preventing others from trespassing into their territories, while at certain circumstances one sees some of them engaged in waste scavenging over legitimate ownership of a particular piece of broken plastic bowl.

The preoccupations of government on environmental policies are in the areas of environmental sanitation, degradation and pollution control. Hence, one can see that there is no linkage between government formulated policies on environment and the activities of waste scavengers. Various governments have failed to recognize and formalize scavenging, despite its importance in terms of job creation and income generation to a large number of youths. Scavenging is an important survival strategy

in which impoverished individuals cope with hunger and unemployment. Scavengers typically specialize in recovering only one or a few types of materials from waste. The recovery of materials from waste by scavengers takes place in a wide variety of settings, although the circumstances in which materials are recovered in a particular place may be unique. It is obvious that scavengers source their materials from two major ways, that is, either sorting or collecting freely from dumps and landfills, or by buying the already sorted materials from households.

The following features characterize scavengers: they are poor, relative to the rest of the society, their incomes are low, and scavenging is an informal activity and is labour-intensive in nature. It can render economic and social benefits (such as; work for the unemployed youths, raw materials for industry etc.). On the other hand, scavenging generates cost to society such as high health risk associated with the type of labour. Scavenging supplies raw materials largely to either artisans or industries. In dumpsites located near agricultural areas, scavengers recover organic materials to be used as fertilizers as well as food for goats and pigs (Medina, 1997).

The socio-economic impacts of scavenging include reduction of the amount of solid waste in the environment and also helps to save the natural resource that leads to sustainable development. It creates jobs and extra income for people, especially the poor. Scavenging encourages family members to sort out materials from wastes in exchange for money. It supplies raw materials for a lot of recycling enterprises and this creates more jobs for people especially the youths who dominate the activity.

Scavengers are however vulnerable to diseases, as garbage dumps contain sharp objects like disposable syringes and needles that might have been used for treating certain dangerous diseases like HIV/AIDS or hepatitis. Razor blades, broken bottles and pieces of metals found in garbage dumps may cause injuries that could also lead to tetanus which may even result in death. Other diseases which could also be contracted by scavengers include typhoid fever and cholera which may be transmitted to others, while animal and human faeces may cause intestinal worms to those infected.

Some youth that engaged in waste scavenging were observed to be drug addicts. They need counselling and rehabilitation. Most of the youths who engage in scavenging are drop-outs who should be in school or learning a trade. Any child who is below the age of 15 and is working is engaged in child labour. It is therefore recommended that Kano State government, in conjunction with Non-governmental Organizations NGOs as well as Community Based Organizations CBOs should train the youth scavengers

on how to go about their activities in a way that maximizes profit. Attached to this point is the need for the state government to encourage scavenging and make the activity less vulnerable and more efficient, this can take the form of provision of necessary working equipment like hand gloves, boots, wheel barrows and a little working capital. The scavengers should receive basic health training (first aid) to learn how to take care of themselves in case of any minor injury. They should also be trained to wear a type of uniform, such as overalls, jungle boots, gloves, helmets, and nose masks, which would further enhance their dignity and health status.

The constraints to waste collection in Kano metropolitan area was investigated in 2011 using survey method to elicit information. Questionnaires, Key Informant Interview (KII), and Focus Group Discussions (FGD) were used as instruments for data collection. The study population included households, Refuse Management and Sanitation Board (REMASAB) officials and Environmental Health officers of the Municipal Local Government Area. Samples were drawn from the high, medium, and low density areas of both the traditional city and township. The population of Kano metropolis according to 2006 census was 2,163,225. Out of this population, a sample of 1015 adults male (household heads) only was selected. This is by no means discounting the role of women on waste management. Men were however selected because of their culturally-ascribed decision power on matters affecting household health and sanitation. Two hundred and seven (207) from low density and high income Nasarawa G.R.A, three hundred and seven household heads from medium density (Hotoro, Kawaji, and Kabuga) and five hundreds and one (501) from high population density areas (Gwagwarwa, Jakara, and Danbazau) were sampled. While the Director Operations of the State Refuse Management Agency (REMASAB) and six Environmental Health Officers were interviewed, focus group discussion was held with household heads too.

It was discovered that, the respondents are predominantly young. They are largely (41.8%) below 40 years and thus at their prime age of production (agricultural or industrial). They fall within the productive age of the population and are liable to purchase and consume both industrial and agricultural products and consequently generate wastes. It is therefore not unexpected when volumes of wastes are generated by this age group who are typically susceptible to consumerist lifestyle of the urbanites. The fact also that a majority are married is an indication that the potentials of waste generation is there, the family being a consumption unit in urbanized society is mostly associated with waste production.

The respondents largely (69.6%) have 1-4 children. This indicates that their family size is growing. Waste generation at macro level is associated with the size and economic strength of a population while at household (micro) level, waste generation could be a function of the size of the family. This suggests that, because majority of the residents in metropolitan Kano are married and have many children, and (therefore large enough to produce high quantity of waste), the problem of managing Kano waste could be among other things related to dense population of the metropolis. Waste management system implies the methods and or mechanisms applied in managing wastes.

According to the Refuse Management and Sanitation Board's (REMASAB) official: The board employs the mechanism of collection and disposal of solid wastes at the following dump sites: Maimalari, Bompai, Hajj Camp, Gyagyadi, Dala, and B.U.K Road but the mechanism is not effective when we consider the amount of solid waste generated in urban Kano. The board itself is not satisfied with the present day situation due to lack of enough funds for personnel and equipment.

The finding reveals that the common waste collection system is the communal collection. According to the REMASAB's official, a total of 2,732 tonnes of (known) waste are accumulated daily in metropolitan Kano and the board is able to evacuate 800 tonnes from the total accumulated on a daily basis at full capacity. This implies that the amount of waste collected or cleared everyday (800 tones) is less than the amount generated (2,732 tones). The problem of waste collection as indicated above is alarming and therefore, needs an urgent attention. This further explains the ineffectiveness of the collection system. However, some noticeable problems are further compounding the ineffective collection system. For example, most locations in the city are inaccessible for waste collection or ambulance services. This means that even when facilities are available, they could not be effectively used in such obscure location resulting in the waste may accumulating for a long time. Thus, besides ineffectiveness in relation to capacity and shortage of personnel, there is also structural problem as some locations especially in the walled city are difficult to access by the waste clearing vans. REMASAB has a total of 132 regular staff including the recently posted Environmental Health Officers from the Ministry of Health, and 3508 casual workers (collectors).. This work force is grossly inadequate for effective collection service. Therefore, it is possible for waste to be accumulated in an area for months without being cleared. This of course endangers health. Again, the result of the FGD confirmed this same problem.

According to one of the discussants, “They (collectors) have no regular schedule; they only come when contacted by the community. We invite them whenever we had communal work on waste clearance.” It is recommended that there is the need for Kano State government to increase the involvement of the private sector in the collection and disposal of waste within the metropolis. The privatization of the waste collection is likely to be more successful in high and middle income areas of the study area since that entails payment of some stipend in return.

In 2014 a study was conducted titled: “Participation in Solid Waste Recycling Process in Kano: The Case Study of Jakara Ward.” It was aimed investigating the willingness to participate in solid waste recycling process with a view to making policy recommendations. Households in Kano city generates and store large volumes of waste materials, however little is known about their willingness to recycle. Attempt was made to empirically assess this willingness towards recycling process which includes recovery, reuse and recycling. The scope of the study was also based on municipal solid waste identified as iron, plastics, paper, glass and aluminium only. Jakara Ward, which is the area of study is situated in the heart of Kano city in Dala Local Government Area. Roadside hawking, trading and dumping of refuse are what characterize the study area. A micro-econometric modelling technique was employed and a sample of 120 respondents was selected in Jakara Ward. Logistic regression was adopted using the maximum likelihood method.



Fig 13: *Jakara Bola. (The study area)*

Findings discovered that the income earned from recycling processes and the volume of waste recyclables are the major determinants of willingness to recycle. While the low income households are more willing to recycle, the high income households are less willing to recycle. Female members of households were found to be more willing to participate in recycling process compared to their male counterparts. Waste separation and sorting starts from households and is mainly being done by females and later the process is completed by males who buy the scraps, upgrade it and sell to salvage dealers who in turn sell it to recycling firms. The recommendations here is that separation and sorting should be further encouraged by all the stakeholders.

The willingness to pay for waste collection and disposal services in Kano Metropolis, Nigeria was empirically researched using Contingent Valuation (CV) method in 2015 because one of the major reasons for valuing waste collection and disposal is the assumption that a well-designed survey aimed at determining the willingness and capacity of household to pay is a key factor in addressing challenges of improving the efficiency of waste management system in urban areas.

The study explored the possibilities of applying contingent valuation method to estimate households' willingness to pay (WTP) for waste collection and disposal in Kano Metropolis. The study area was particularly chosen in this context because it is one of the states in Nigeria battling with management of a large volume of household waste and there is a move recently to involve the private sector in providing waste collection and disposal services, a policy that is a clear departure from the notion that local authorities must be responsible for providing waste management services free of charge in the area, the rationale for this new policy is based on the fact that public waste collection is not efficient and that inclusion of private sector is expected to bring about efficiency as has been noted in other sectors of the economy.

This study selected and studied 326 households for the survey. In order to ensure the sample households were representative of the population, the study area was stratified into three sampling units each representing different income groups (high, middle and low income areas) as a first stage. Thereafter, a sample was proportionately allocated into each sampling unit (strata) according to each share of total households or residential population density. For this, in each sampling unit or strata, the sampled households were chosen through multi-stage sampling. That is, since each sampling unit (strata) is composed of different residential areas, a number of residential areas were selected at random as second stage of the sampling process. The third stage involved the selection of residential structures.

From the estimated result, the relationship between the probability of household's willingness to pay and the age of the households is negative and significant at level of 1%. In particular, the marginal effect suggests a decrease in household age is likely to increase probability of household's willingness to pay by 0.45%. Therefore, the result implies that old people are less willing to pay than young respondents for an improved waste collection and disposal service in Kano Metropolis. This may be explained by the fact old people tend to consider environmental issues less important. The result also revealed that all things being equal, there is an inverse and significant relationship between respondents' willingness to pay and gender of the household at level of 1%. By implication, since in this study male respondent carried the weight of 1 and female respondent 0, it suggests that female respondents are more willing to pay for improved waste collection and disposal service in the study area than their male counterparts. The result of marginal effect also suggest decrease in probability of one being male increase the likelihood of household's willingness to pay by 44%. The estimated result also revealed that coefficient of the respondents' occupation carried a wrong sign but statistically significant at level of 1%. This suggests households who have an occupation are less likely to pay for waste collection and disposal services.

The coefficient of respondents' level of education was found to be statistically significant in explaining household's willingness to pay at 1% level. It has a positive sign and therefore, consistent with previous studies that found education to have positive and statistical effect on willingness to pay for improved waste collection and disposal services. The result of its marginal effect suggests that the qualification of the respondents is more likely to increase the probability of household's willingness to pay by at least 54%. The respondents' monthly level of income was also found to be positive and significant in raising the ability of household's willingness to pay for waste collection and disposal services. The coefficient of the income from its marginal effect also suggests any additional increase in monthly income would increase the probability of household's willingness to pay by 100%. This confirms our a priori expectation because ability of a household to pay largely depends on the income.

The coefficient of family size also has positive and significant influence on willingness to pay at 10% level. Therefore, the marginal effect of the variable implies that 1% increase in a respondent family size would probably increase household's willingness to pay by 0.9%. This is probably true because as the size of family increase, the tendency to generate more waste also increase, and ultimately induce household's willingness to pay. The study also found a relationship between utility derived from service delivery and household's willingness to pay was positive and

significant at 1%. The estimated marginal effect of this result suggest that as utility derived from service delivery increase, the probability of household's willingness to pay also increase by 72%. It is recommended that government should franchise waste management services in Kano metropolis especially in high and middle income areas, since residents are willing to pay to compensate for the higher cost of providing improved waste collection and disposal services in the area. A direct collection fees method may be one of the feasible ways to collect money for supporting improved waste management services but there is need for comprehensive policy measures for making the method to be more realistic and practicable. Since we can also link the satisfaction derived from service delivery with the knowledge of health and environmental implication of improper waste collection and indiscriminate waste disposal, government and other stakeholders must further educate the public on proper method of waste disposal in Kano metropolis. This would assist to improve understanding of the household's willingness to pay and provide policy makers with a useful information for effective and efficient waste management policy.

Based on the relationship between poverty and environment, Poverty alleviation is considered as one of the most difficult challenges facing countries in the developing world where, on the average, majority of the population is considered poor. Evidences in Nigeria show that the number of those in poverty has continued to increase. Therefore, a research on poverty alleviation as machinery for economic reconstruction in Nigeria was undertaken. This research was aimed at appraising the performance of poverty alleviation measures undertaken within the period 1999 – 2006, specifically the Poverty Alleviation Programme (PAP) and the National Poverty Eradication Programme (NAPEP).

The methodology employed was the use of secondary source of data. Information was gathered through reports, publications, the internet and other secondary sources of data. Specifically, data were collected from the Central Bank of Nigeria and the National Poverty Eradication Council (NAPEC). The collected data were analysed using simple content analysis. In 1999 when the Obasanjo administration came to power, it was estimated that more than 70% of Nigerians lived in poverty. That was why, in November 1999, the N470 billion budget for year 2000 was to relieve poverty. Before the National Assembly even passed the 2000 budget, the government got an approval to commit N10 billion to poverty alleviation programme (Ogwumike, 2001). Poverty alleviation was seen as a means through which the government could reconstruct the economy and rebuild self-esteem in majority of Nigerians. Among the poverty alleviation programmes were: the launching of Universal Basic Education (UBE)

Programme, the Poverty Alleviation Programme (PAP) and the National Poverty Eradication Programme (NAPEP).

The Poverty Alleviation Programme (PAP) was introduced in 2000 to address the problems of rising unemployment and crime rates especially among the youth. The primary objectives of PAP, are as follows:

- i. Reduce the problem of unemployment and hence, raise effective demand in the economy.
- ii. Increase the productiveness of the economy.
- iii. Drastically reduce the embarrassing crime wave in the society.
- iv. The targets/components of PAP as identified by Obadan (2001) include the following:
- v. Provide jobs for 200,000 unemployed.
- vi. Create a credit delivery system from which farmers will have access to credit facilities.
- vii. Increase the adult literacy rate from 51% to 70% by 2003.
- viii. Shoot up healthcare delivery system from its present 40% to 70% by year 2003.
- ix. Increase the immunization of children from 40% to 100%.
- x. Raise rural water supply from 30% to 60% and same for rural electrification.
- xi. Embark on training and attainment of at least 60% of tertiary institutions' graduates and
- xii. Development of simple processes and small scale industries.

Several measures were put forward in order to achieve the above objectives and they include among others, increase in the salary of public workers, rationalization of organizations and methods within the system, particularly that of the existing poverty alleviation institutions, encouraging and rewarding all deserving Nigerians for industry and enterprise, substantial reduction of avenues for easy and illegitimate acquisition of wealth and the launching of the Universal Basic Education Programme.

Poverty Alleviation Programme (PAP) was designed to touch almost all aspects of poverty ranging from absolute to regional poverty. It was however more specific in curbing unemployment hence raising the income of individuals so that their spending would increase and hence their needs be satisfied. However like in most programmes, PAP was hindered by poor implementation and being short term in nature it lacked continuity. The aim of the programme was defeated as credits given to finance micro enterprises were not utilized by the beneficiaries in such enterprises meaning that the target for employment generation was missed. PAP was also perceived as an initiative

of the ruling party's programme and therefore was not given much attention and, in some cases, resisted by chief executives of states controlled by the opposition parties.

National Poverty Eradication Programme (NAPEP) was introduced in 2001. It was aimed at the provision of "strategies for the eradication of absolute poverty in Nigeria" (FRN, 2001) It was complemented by the National Poverty Eradication Council (NAPEC) which was to coordinate the poverty reduction-related activities of all the relevant ministries, parastatals and agencies. The council had the mandate to ensure that the wide range of activities were centrally planned, coordinated and complement one another so that the objectives of policy continuity and sustainability were achieved. The poverty reduction related activities of the relevant institutions under NAPEP have been classified into four, namely:

- i. Youth Empowerment Scheme (YES) which deals with capacity acquisition, mandatory attachment, productivity improvement, credit delivery, technology and development and enterprise promotion.
- ii. Rural Infrastructure Development Scheme (RIDS) this deals with the provision of potable and irrigation water, transport (rural and urban), rural energy and power support
- iii. Social Welfare Service Scheme (SOWESS) this deals with special education, primary healthcare services, establishment and maintenance of recreational centers, public awareness facilities, youth and students hostels development, environmental protection facilities, food security provisions, micro and macro credits delivery, rural telecommunications facilities, provision of mass transit, and maintenance culture.
- iv. Natural Resource Development and Conservation Scheme (NRDCS) this deals with harnessing of agricultural, water, solid mineral resources, conservation of land and space particularly for convenient and effective utilization by small scale operators and the immediate community.

NAPEP was centred on youth empowerment, provision of infrastructures, social welfare scheme and natural resource development/conservation. It was however broad based and encompassing. It tried to adopt the participatory, bottom-up approach in programme implementation and monitoring. However, a critical assessment of NAPEP revealed that it concentrated more on the youth empowerment scheme (YES) neglecting the other mandates. Even the YES itself focused more on the disbursement and administration of NAPEP's vehicle popularly called "KEKE NAPEP". On the issue of natural resource development and conservation scheme, Abdu (2005)

observed that less than 20% of the target beneficiaries have benefited from this scheme. This means that NAPEP has not made much impact in harnessing agricultural, water and solid mineral resources and conservation efforts especially in the rural areas where the main occupation is agriculture.

It has also been observed that most of the poor people have not participated in NAPEP's programmes due to lack of access to social and economic infrastructure provided to improve human capital. By and large, the local people were not included in the identification of projects meaning that the ones identified were in most cases, inappropriate and unsustainable. It was also observed by Abdu (2005) that in most localities, the credit facilities and other infrastructure provided by NAPEP was enjoyed by members of the ruling party while those identified as opposition were denied access and did not benefit from the programme thereby remaining in poverty. To crown it all, even where the ruling party loyalist were given the credit facilities, the funds were in many cases utilized for other purposes the result of which was that, in the long run the intended beneficiaries remained poor.

One of the greatest achievements of both PAP and NAPEP was the success of the programmes in providing jobs to a number of youth across the country. Through NAPEP's Youth Empowerment Scheme, a lot of unemployed youth acquired entrepreneurial and business skills in many areas resulting in the relative increase in their income levels. The Universal Basic Education which is a strategy employed by PAP in increasing literacy rate also made an impact in many communities where classrooms were constructed and learning materials provided for the benefit of the citizens.

However a lot of problems have been encountered in the process of implementing the programmes. These problems includes: lack of involvement (in most cases) of the local people in the identification of projects, administrative and operational problems and above all, the failure in the selection of the target beneficiaries due to political reasons. Considering the current poverty incidence in the country, one can conclude that the past poverty alleviation programmes have not achieved much. This is perhaps due to the problems identified as hindering the effective implementation of the programmes. The objectives and mandate of both PAP and NAPEP were aimed at provision of employment and income generation through various activities; however lack of involvement of the target beneficiaries in identifying the right projects coupled with administrative and operational failures were among the problems identified as hindering the achievement of the objectives of the programmes.

A joint research was conducted titled: “Cost of Illness in Patients With Mandibular Fracture Following Road Traffic Crash and its Socio-economic Implications in Kano State, Nigeria.” It has been observed that there is an upward trend in facial injuries following changes in population patterns, increasing industrialization and urbanization, hence maxillofacial trauma is becoming a burden and leading medical problem in emergency rooms worldwide. The cost of medical treatment in the world continually increases as a result of a number of economic and social factors. Majority of treatment costs consist of the direct costs, which includes hospitalization cost and cost of medications that consequently increase with duration of treatment. The huge financial burden as a result of management of maxillofacial injuries, including mandibular fractures, to various Governments and communities amount to more than those for the treatment of other diseases

Cost of Illness (COI) was the first economic evaluation technique used in the field of health care to measure the economic burden of illness to society and it is useful as a decision-making tool. The economic and social implications of mandibular fractures have motivated researchers in many countries into the incidence and causation of road traffic crashes (RTCs), the injuries sustained and how these may be treated. Understanding the COI would thus provide some important benchmark values for decision makers in assessing the economic burden.

All the consecutive patients managed for mandibular fractures following road traffic accident at the Maxillofacial Surgery Department of Aminu Kano Teaching hospital, Kano, Nigeria from July 2013 to June 2014 were included in the study. This centre is a major referral hospital in the North-Western region of Nigeria with a bed capacity of 600. Data collected included the demographics of the patients educational status, bone fracture (type of fracture and mode of treatment i.e. both wire osteosynthesis and use of bone plates), aetiology of injury, management and outcomes, treatment costs, number of work days lost by the patient, duplicate copies of individual treatment costs were in the patients’ folders containing patient records and the few that were missing were obtained from the Accounts Department of the hospital. These details were filled in the appropriate sections of the questionnaires designed for this study. Eight hours is the average work hours per day in Nigeria and the average income per person for 2014 according to World Health Organization (WHO) was \$3,203 (using the conversion rate of N183 - \$1). These were used to convert the lost time and lost days into monetary terms. The total COI of the patients was then obtained from the addition of the direct and indirect (non-medical) cost and the final value obtained was divided

by the total number of patients; the resultant value was used to determine the average cost of illness per patient.

At the end of the study, 50 patients were diagnosed with mandibular fracture. Days out of work was 646 days (at 8 hour/day, using the average income of N1610.4 per day) 23.3 hour loss of care givers was 308 (which is equal to 38.5 work days). With a total cost of illness of N4,465,907.80 for mandibular fracture in a year, the average cost of illness will be N89,318.20 (\$488) per person. Direct cost of illness for mandibular fracture was N3, 198,139.00 Giving a direct cost of illness of N63,962.90 (\$350) per affected person. Direct non-medical/indirect cost of illness was N1,267,768.80 thus giving an indirect cost of illness of N25, 355.40 (\$139) per person. Using past studies which gives us a road traffic injury rate for Nigeria as 41 per thousand and facial injury rate of 3.4% of which 28.5% are mandibular fractures. Extrapolating this to Kano state with a population of, 9,383,682 people, the mandibular fracture rate would be 3,753 persons per year. Cost of illness for- mandibular fractures in Kano state per year would be N335,211,205 i.e. \$1,941,045.

The average direct cost of illness for mandibular fracture was observed to be N62,962.3 per person which is higher than the direct cost of illness for Type 2 diabetes alone (N45,531.19 per person) and even higher than the cost of illness for individuals with both Type 2 diabetes and hypertension (N59, 607.66) in Nigeria. This shows how expensive it is to manage the condition even when compared to two major diseases like hypertension and diabetes. Cost of illness for mandibular fractures was observed to be equivalent to 8.4% of the total healthcare budget for the state in the year of study and 15.2 % of the GDP per capita. This highlights how expensive it is to manage the disease and the resultant loss to the individual and the economy of the state. It has been documented by previous studies that when up to 10% of a household's income is spent on health, then it is suggestive of catastrophic financial standing. So suffice it to say that the cost of mandibular fracture being up to 15.2% of the average individual's annual income is quite enormous especially in a country like Nigeria where about 95% of patients pay out of pocket for health. Even a disease like malaria which is endemic in the country and potentially fatal, costs less at less than 10% of household spending annually.

Mandibular fracture occurs with the highest frequency in the 21-30 year age group which constitutes the economically active population. It can be observed that loss of productivity due to the disease alone cost 24.7% of the total cost of illness and formed the bulk of the indirect cost of the disease. This translates to costing the state at least

N82,797,168.00 per annum which is significant economically. An important measure that has to be taken is to increase health care subsidization through increased insurance coverage and support from development partners. This will all reduce the burden of mandibular fracture on the individual and the society.

In 2014, the nexus between health outcomes and economic growth in Nigeria was examined empirically in order to find out whether a long run relationship exists between them as over the years, the contribution of human capital to economic growth has been widely acknowledged with vast empirical studies mainly defining human capital in terms of education. However, the fact that human capital matters for economic growth and that health is an important component of human capital, then health is also expected to play a key role in the development process. For instance, health improvements impacts positively on household

Using annual time series data, Augmented Dickey-Fuller (ADF) test was conducted to check the stochastic properties of the variables. Also, the long run relationship among the variables is confirmed based on Johansen Multivariate Cointegration approach whereas the long run and short run dynamics are observed using Vector Error Correction Mechanism (VECM). In addition, VEC Granger causality test is employed to examine the direction of causality among the variables. The data set for this study consist of annual time series spanning from 1961 to 2012. The variables under consideration are log of real Gross Domestic Product (LRGDP) as a proxy for economic growth, and life expectancy and crude death rate to stand for the variables of health outcomes. Other control variables used in the study include trade openness and net income from abroad. The data were sourced mainly from the publications of World Development Indicators. To test the nature of association between the variables while avoiding any spurious correlation.

From the results, a negative relationship is found to exist between life expectancy and economic growth. This is contrary to the a priori expectation indicating that a 1 year increase in life expectancy brings about 1.01 decreases in economic growth over the long run horizon. This of course is found to be highly significant judging from the t-statistics of approximately 9.3 which is greater than the standing rule of two. Thus, in the long run, life expectancy affects economic growth negatively in Nigeria. This is in contrast to the theoretical arguments that longer life expectancy leads to the gains in productivity. Thus, the long run negative impact of life expectancy on economic growth in Nigeria is most likely to be the consequences of increase in population accompanied by increase in unemployment and prevalence of diseases. For instance,

illness may reduce the productivity of the affected individuals and consequently reduce GDP.

In relation to crude mortality rate, the result reveals the existence of negative and statistically significant relationship with economic growth. Precisely, the value of the coefficient shows that in the long run, a 1% increase in crude mortality per 1000 population leads to a reduction in economic growth by 11.4%. This is in line with the theoretical arguments and a priori expectation of the study. Similarly, the coefficients of the control variables supported the a priori expectation although that of trade openness is found to be highly insignificant based on the t-statistics of less than two. On the whole, the results obtained revealed the existence of a long run relationship between health outcomes and economic growth in Nigeria and that both life expectancy and crude death rate as measures of health are found to have a long run negative and statistically significant impact on the economic growth over the study period. This is further buttressed by the results of Granger causality test which indicated the existence of unidirectional causality running from life expectancy and crude death rate to economic growth.

The study therefore, calls for governments at various levels to create preconditions for health improvements in Nigeria in order to boost the level of health outcomes. To this end, the study concluded that there exist a long run equilibrium relationship between health outcomes and economic growth and that, improvements in health status is said to be among the various factors influencing economic growth in Nigeria. However, the extent to which improved health status can affect economic growth strongly depend on a number of health determining factors, including rising standard of living, lifestyle as well as better education opportunities and greater access to quality health services. Therefore, policies intended to improve the level of health status of the population for sustainable economic growth should take these factors in to consideration.

Estimating the non-medical indirect cost of treating malaria in Kaduna, Nigeria is part of my efforts to contribute to health economics as the health of population is mostly being affected negatively due to poor environmental practices. It was observed that Malaria is a major health problem in many developing countries where it accounts for many cases of death and has caused a significant loss in both productive time and income of households. Despite the economic losses it exerts on both the patients and the caregivers, the cost of treatment seeking for malaria disease by households in Kaduna Metropolis has not been well documented. However, knowledge about the cost of malaria treatment can have influence on the health care seeking behaviour of

individuals and justify the need to reduce an increasing number of productivity time loss of households and income loss of care giver due to malaria treatment seeking behaviour.

The study was carried out in Kaduna metropolis, an area that comprised four local government areas namely: Kaduna North, Kaduna South, Igabi and Chikun Local Government Areas. The study was conducted in six different areas purposely selected to represent different malaria ecologies in the metropolis. The areas are Kabala West, Rigasa, Tudun Wada, Kinkinau, Sabon Tasha, and Kawo. The choice of Rigasa and Tudun Wada was informed by the fact that they represent areas with low, unstable transmission that are prone to malaria epidemics. Kinkinau and Kawo represent areas with low acute transmission, while Sabon Tasha and Kabala West represent areas with intense transmission. Therefore, these areas are well known for growing out-patient cases of malaria with attendant open drainages and irregular site for refuse dump which encourage the breeding of mosquito. A total of three hundred and thirty (320) structured questionnaires were distributed randomly among the selected households within Kaduna metropolis.

Estimation of productivity time loss was based on the average time households spent waiting for various services at the health provider in terms of average waiting time for obtaining cards, consultation, laboratory services and injections. The time loss was obtained and valued in monetary terms by dividing the official monthly minimum wage by the working days in a month to obtain the daily wage rate thereby divide the daily wage rate by daily hours of work to arrive at the wage rate per hour. Majority of the households spent about 3.5 hours waiting to see a physician for consultation while about 1.1 hours are spent on joining the queue to prescribe drug or taking injection, 1.2 hours on registration and payment to obtain a hospital card while 1.4 hours are spent to obtain laboratory services. On average, a total of 7.2 hours are spent waiting to obtain various services per malaria episode in the study area. Therefore, this implies that a household loss a substantial productivity time per malaria episode.

In addition, an average total of N736.42 (US\$4.60) was lost by households on waiting time to obtain various services in the hospital/clinic per malaria episode and the annual average total loss stands at N8837.04 (US\$55.23) for the annual productivity time loss on waiting time to obtain various services in the health providers for seeking malaria treatment. Estimation of loss income due to care giving for malaria patients was estimated by multiplying the amount of average daily wage rate to be earned by a caregiver in their occupation with the average number of days that a care giver forgoes

to take care of a malaria patient per episode. The total average monthly loss in income by the caregivers when taking care of malaria patients was N22643.90 (US\$141.52) with the annual loss of income by caregivers amounted to N8, 265,023.50 (US\$51656.40). Self employed caregivers are likely to incur the greatest average loss in earnings to the tune of N11784.47 (US\$73.65) than other occupations.

Income loss due to malaria was observed to carry a positive coefficient and is statistically significant at 5% level as indicated which implies that as households were attacked more by malaria, they are likely to lose more income and earnings. This suggests that malaria has a positive relationship with the amount spent in its treatment by patients and the caregivers. In other words, the more the malaria cases in a given family, the more the households to spend certain part of their income in treatment seeking.

The main findings of the study are that distance to health provider and travelling time has significant negative effect on indirect cost of malaria treatment incurred by household. The result also revealed that the coefficient of days lost due to malaria sickness and income loss due to malaria attack are positive and significant which implies in the first malaria attack increase the likelihood of losing productivity time as well as loss of income. In addition, the result also shows that majority of households' loss between 1-4 hours of their productive time before obtaining various services at the health providers with large proportion of the time spent on waiting for consultation service. Both the economically active patient and the caregiver lost significance days seeking for malaria treatment, with an average of 10 to 14 days loss to patients and 7 days loss to care takers.

Determinants of food insecurity in Nigeria, the application of binary choice modelling technique is considered vital as one of the consequences of climate change is decrease in crop yield and subsequently leading to food insecurity. Food insecurity is one of the most bedevilling issues and among the most challenging socio-economic problems for many countries in the world today, particularly the developing economies. Although Nigeria is among the major producers of food crops such as yam, cocoa and cassava, it has deficit in terms of certain crops because it imports rice and wheat, maize and sorghum as such most of the people are food insecure. The research was aimed at examining and analysing the determinants of food insecurity among some selected households in Kano State of Nigeria, and also to estimate the extent of food insecurity situation among the households. The significance of this is in order to find out the

major determinants with a view to make policy recommendations on how to curbe the menace and achieve food security.

The result obtained showed that households' income, educational qualification, gender, size of household, assets owned by households and access to credits are among the major determinants of food insecurity. It was further found that the income earned by households is an important determinants of food insecurity as food expenditure are backed by incomes. Other determinants were gender, status and educational qualifications of respondents. This may be due to the fact that the respondents underestimates their income levels due to fear of taxation which might be due to measurement error or mis-specification of the mathematical model. Nonetheless, the variables have succeeded in explaining the probability of households to be food insecure. The coefficient of access to credit does not carry the correct sign because under normal circumstances, the more the access to credit facilities, the less will be the food insecurity situation; however the access to credit here may only be an opportunity but at the end the credit facilities might not be extended possibly due to inadequate collaterals by the households or inefficiencies on the side of the financial institutions. Other reasons that might account for the wrong sign are that the credits accessed are not used for consumption purposes and at the end, due to high repayment rates, households that accessed credits are worse off and hence the credits worsens and increase the food insecurity situation.

It was also deduced that households that were headed by females are, in most cases, food insecure as this results from the death of the breadwinners who were in most cases males that had high opportunity to work and earn income to sustain their families. The female-headed households were more food insecure as females were not fully participating in income earning activities due to the culture and religion prevailing in major parts of the study area (northern part of Nigeria) which limits women from coming out to work and earn income. Based on the findings, it is recommended that there is the need to generate employment opportunities and create more income-earning activities by respective governments in Kano in order to empower the households so that the food insecurity situation can be reduced. Female heads of households should also be empowered using micro-finance/micro-enterprises to alleviate their food insecurity.

CURRENT AND FUTURE RESEARCH

Assessment of the Impact of Climate Change on Gender and Food Security in Sub - Saharan Africa

Attention to gender in climate change policy processes have been neglected in Sub-Saharan Africa, while there is increasing focus on the need for adaptation along with mitigation policies. Although the UN's Intergovernmental Panel on Climate Change (IPCC) was formed in 1988, it was only in its Third Assessment Report (IPCC 2001) that reference was made to gender, its appearance is very limited, and with little or no discussion of what this might mean for policy. 'Gender' appears ten times in the context of statements about: sex-differentiated levels of vulnerability as a consequence of the 'feminization of poverty'; the particular plight of women during disasters; and the use of gender analysis to map social vulnerability. In the years that followed, a series of articles and reports were published on gender and climate change, building the case for its inclusion (with a particular focus on women) in climate change policy. Existing studies on climate change in sub-Saharan Africa have mainly focused on the gender and environment relationships. Most of the studies on gender and climate change mainly on crop production, forestry and fisheries, as well as in health lack supporting evidence as regards to sub-Saharan Africa. The broad goal of this research is to examine the relationship between women's work within the context of the challenges of climate change so as to justify placing women at the centre of climate change policy since they are rendered vulnerable, weak, poor, and socially isolated most especially due to prevalence of culture and social influences.

Specifically, the research will examine and analyse the impact of climate change on; food availability, food accessibility, food affordability and food sustainability by women in sub-Saharan Africa. Significance in the context of climate change, traditional food sources become more unpredictable and scarce. Women face loss of income as well as harvests—often their sole sources of food and income. Related increases in food prices make food more inaccessible to poor people, in particular to women and girls whose health has been found to decline more than male health in times of food shortages. Furthermore, women are often excluded from decision-making on access to and the use of land and resources critical to their livelihoods. It is against this background that, the research is justified so that the value addition and findings will guide policy makers on how to empower women to achieve food security, and to appropriately cope with the effects of climate change. sub-Saharan Africa made little accomplishments in achieving food security and economic and social transformation across its regions. Two major trends remain worrisome, Sub-Saharan countries located in West Africa (Niger, Nigeria, Ghana, Burkina Faso, Republic of

Benin and Togo) lag behind their counterparts in economic and social transformation; and significant disparities remain across gender, in this region. Particularly worrying is the fact that women are disadvantaged due to social and cultural influences.

Food availability often remains the predominant aspect used in food security analysis and measurement. Indicators used to measure food availability include crop production and/or food production indices, livestock ownership indices, and national food balance. Accessibility to food, or the ability to acquire food, is influenced by income level, access to resources, and the physical and social environment, the cost of food, and government and trade policies. Food access has a strong institutional component. Access to food is often measured using proxy, entitlements-based indicators such as food consumption, food price monitoring, income, or assets. In rural sub-Saharan Africa, the majority of the population practices subsistence agriculture, and supplements food stores with purchases from the market. When food is available and accessible to a household, it does not mean that the household is food secure, unless the food is affordable, safe, and socially acceptable by the members of the household. Determinants of food affordability include the ability to physically buy food or to demand it and the demand to be backed by purchasing power.

Saharan Africa is the term used to describe the area of the African continent which lies south of the Sahara Desert. Geographically, the demarcation line is the southern edge of the Sahara Desert. Generally, sub-Saharan Africa is the poorest region in the world, still suffering from the legacies of colonialism, slavery, native corruption, and inter-ethnic conflict. The region contains many of the least developed countries in the world. There are 42 countries located on the sub-Saharan African mainland, in addition to six island nations (Madagascar, Seychelles, Comoros, Cape Verde and São Tomé and Príncipe). However, this research will cover four countries which include Niger Republic, Nigeria, Ghana and Burkina Faso.

Both primary and secondary data will be collected and used; survey will be conducted by research assistants. The survey will use multidimensional approach to generate detailed, multi-sector and policy-relevant data from all four countries. A well-structured questionnaire will be designed and administered to gather relevant information. More so, supplementary data will be drawn from published literatures and reports.

Expected outcomes and contributions of the research will explore the various ways in which climate change affects the women's accessibility availability affordability and sustainability of food in sub-Saharan Africa it will also explore the ways in which gender will be incorporated into climate change policy. The expected findings of the research are that, for changing the starting point for developing gender-responsive climate change, policy focus on the analyses of social, economic and political situations along with information on adaptations to change are necessary. The impact of climate change on gender and food security is hypothesized to retard progress towards gender equality and may likely pose challenges to poverty reduction efforts; on the other hand, gender inequality can further worsen the effects of climate change. Therefore, the findings of this research would be used to mitigate climate risks so also it will provide a policy signal in adaptation to ensure success and sustainability of government and non government based projects aimed at gender empowerment and enhancing food security.

Conclusion

Having examined the relationship between man, the environment and the economy, a number of conclusions can be drawn. First, the natural environment is considered as the provider of resources to man in form of both land, water, air and the mineral deposits under the earth crust. Man however, in search for economic satisfaction have subdued nature and succeeded in degrading the natural environment, this degradation manifest itself in forms of land pollution, air pollution, water pollution, thermal pollution and other forms of pollution. The environment is considered a common property resource, and the polluting agents are not making efforts to abate the pollution unless compelled by relevant bodies to do so. Global warming and climate change are some of the consequences of environmental pollution and have adverse effects on the welfare of people and the environment at large. Poverty on the other hand has adverse effects on the natural environment.

It is based on the sour relationship between man, environment and economic activities that researches on solid waste management, cost of illness analysis as well as poverty and food insecurity were conducted over the years. The researches were aimed at reconciliation and are policy oriented as well. The various researches and policy recommendations, if well implemented will help towards striking a balance between man and environment and will ultimately lead to realization of sustainable utilization of the natural environment and at the same time guarantee a sustainable economic growth and development.

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I also like to thank my family, friends and students and all of you who have spared their time to travel and attend this lecture. Thank you all and may Allah bless you.

References

- Abdu, H. (2005), "Impact of National Poverty Eradication Programme (NAPEP) on Income Changes in Rural Areas" Unpublished seminar paper, Abuja.
- African Development Bank (2009a), 'Information Note on the Checklist for Mainstreaming Gender and Climate Change In Projects'. African Development Bank and African Development Fund. Tunis.
- Ajaikaye, D. & Adeyeye, V.(2001), "Concepts, Measurements and Causes of Poverty" CBN Executive Seminar, Ibadan.
- Aku P.S & Oladeji, S.I(1997), "Perspective on Poverty and Poverty Alleviation Strategies in Nigeria" NES Annual Conference.
- Aliu, A.(2001), "National Poverty Eradication Programme: Completion, Implementation Coordination and Monitoring" NAPEP Abuja.
- Amaza P.S.,et .al (2006) Determinants and Measurement of Food Insecurity in Nigeria: Some Empirical Policy Guide. Paper Presented at the International Association of Agricultural Economists Conference, Gold Coast ,Australia.
- Boyle G (Ed) (1996) "Renewable Energy: Power for Sustainable a Future" Oxford University Press/ The Open University, Oxford
- Dasgupta, P.(1997).Nutritional Status, the Capacity for Work, and Poverty Traps," *Journal of Econometrics* 77, 5-37
- David G. (1980). Population Growth and Agrarian Change. London, UK: Cambridge University Press
- David, T.(1988). Causes of Hunger: Population or Exploitation. Kaduna Analyst Dansa Publication Ltd: Nigeria.
- Dauda, R. S. (2011). Health as a Component of Human Capital Formation: Does it Matter for the Growth of the Nigerian economy. *Canadian Social Science*, 7(4), 207–218.
- Day at.al, (1999) "Exposure to Power Frequency Magnetic Fields and Risk of Childhood Cancer" *The Lancet*, 354 (9194), 1925 1931
- FAO (2005) Impact of Climate Change, Pests and Diseases on Food Security and Poverty Reduction: In Proceedings of the Committee on World Food Security, Rome, Italy.
- FAO (2011) the state of food insecurity in the world: How does international price volatility affect domestic economies and food security Rome, Italy.
- FAO (2009) Declaration of the World Summit on Food Security. In Proceedings of World Summit on Food Security 18–9.
- FRN (2001), National Poverty Eradication Programme (NAPEP): A Blueprint for the Schemes, NAPEP Secretariat, Abuja, June.
- Goodal B, (1972) "The Economics of Urban Areas" Oxford, Pergam Press

- Hall et.al, (1999) “Biomass for Energy in the Developing Countries” Pergamon Press, Oxford
- Mannion AM, (1991) “Global Environmental Change” Longman Group UK Limited
- Medina M, (1997) “Informal Recycling and Collection of solid Wastes in Developing Countries: Issues and Opportunities” United nations University Working paper
- Mustapha M, (2004) “Solid Waste Management in Kano Metropolitan Area: The need for a more Integrated Approach” Topics in the Nigerian Economy Vol 1 No 1. Published by the Department of Economics BUK Kano Pg. 165 - 181
- Mustapha M, (2006) “Economic Impact of Solid Waste Scavenging in Kano, Nigeria” Journal of Social and Management Studies (JOSAMS) Vol 11, Published by the Faculty of Social and management Sciences, BUK Kano. Pg 51 – 64
- Mustapha M, (2014) “ Participation in Solid Waste Recycling Process in Kano: The Case Study of *Jakara* Ward” Yobe Journal of Economics (YOJE) Vol 1 No 1. Published by the Department of Economics, Yobe State University Damaturu, Nigeria. Pg 167 – 181
- Mustapha M, and Modibbo Haruna Adamu (2014) “An Empirical Analysis of the Relationship between Some Selected Health Outcomes and Economic Growth in Nigeria”. Bayero Sociologist (A Journal of Social Studies). Vol 1 no 5 Published by the Department of Sociology Bayero University Kano, Nigeria. Pg132 – 141
- Mustapha M, and Nura Kabuga Aliyu (2015) “ Empirical Assessment of the Willingness To Pay for Waste Collection and Disposal Services in Kano metropolis, Nigeria. Abuja Journal of Business and Management. Vol 1 Issue 1 Published by the Department of Business management. University of Abuja, Nigeria
- Mustapha M, Malumfashi S.L and Adamu Y. (2011) “Constraints to Waste Collection in Kano Metropolitan Area”. The Sociologist (A Journal of Social Studies). Vol 1,Pg42 – 53 Published by the Department of Sociology, Bayero University Kano.
- Mustapha M, Nura A. Kabuga and Aliyu Y. Ahmad (2014) “Estimating non-Medical indirect cost of Treating Malaria in Kaduna Metropolis: Evidence From a Household Survey. Yobe Journal of Economics (YOJE) Vol 1 No 1. Published by the Department of Economics, Yobe State University Damaturu, Nigeria. Pg 311 – 332
- Mustapha M, Akhiwu B.I, Suleiman H.H and Amole I.O (2015) “Cost of Illness in Patients with Mandibular Fracture Following Road Traffic Crash and its Socioeconomic Implications in Kano State, Nigeria. Journal of West African College of Surgeons. Vol 5 No 4. Pg. 1 – 16 Published by the West African College of Surgeons. www.jwacs-jcoac.org

- Mustapha M, (2008) "Poverty Alleviation as a Machinery for Economic Reconstruction in Nigeria" in Duze M., Habu M and KiyawaI.A. Ed, *Poverty in Nigeria*. Adonis and Abbey publishers, UK pg 188 - 198
- Mustapha M, (2010) "The Youth and Waste Scavenging: Implications for Socioeconomic and Health Hazards" in Baffa A.U and Dandago K.I Ed "Issues in Youth Development in Nigeria: A Multidisciplinary Perspective"pg 217 – 225 Published by Bayero University, Kano.
- Mustapha M, (2012) "Determinants of Food Insecurity in Nigeria: Application of Binary Choice Modeling Technique" in Bandara H.M and Gunasekara K.R.H Ed, *Essays in Social Sciences*. Pg 197 – 210. Published by Godage International Publishers PVT Limited Colombo, Sri Lanka.
- Mustapha M, (2010) "The Role of Scavengers in Solid Waste Recycling in Nigerian Cities" in Radda S.I and et.al Ed. *Issues in Nigeria's Social Problems*. Pg 36 – 48. Published By the Faculty of Social and Management Sciences, BUK Kano.
- Mustapha M, (2015) Insecticide Treated Mosquito Nets (ITNs) and Malaria Control in Kano, Nigeria: A Cost Benefit Analysis. Unpublished Seminar Presented in the Department of Economics Bayero University Kano.
- Obadan, M.I (2001) "Poverty Reduction in Nigeria: The Way Forward". CBN Economic and Financial Review Vol. 39, No. 4. CBN.
- Ogwumike, F.O (2001) Appraisal of Poverty and Poverty Reduction Strategies in Nigeria. CBN Economic and Financial Review. Vol. 39.No. 4:45-71
- Smith, C., (2001) *Environmental Physics*/ Routledge Publishers, London & New York.

LIST OF PROFESSORIAL INAUGURAL LECTURE TO DATE

S/N	NAME	DEPT	DATE	TOPIC
1 st	Emmanuel Ajayi Olofin	Geography	4 th March, 1992	The Gains and Pains of Putting a Water Lock on the Face of the Drylands of Nigeria
2 nd	Garba Dahuwa Azare	Education	24 th June, 2000	BASIC CONCERNS: Revitalizing Nigeria's Primary Education in the New Millennium
3 rd	Dajuma Abubakar Maiwada	Education	29 th July, 2000	Improving Teaching and Learning in University Education with Particular Reference to Bayero University, Kano
4 th	Majekodunmi Oladeji Fatope	Chemistry	7 th July, 2001	NATURAL PRODUCTS SCIENCE: Looking Back and Looking Forward
5 th	Muazu Alhaji Zaria Sani	Nigerian Languages	13 th October, 2001	A focus on Some Segmental and Suprasegmental Features in Hausa Phonology
6 th	Isa Hashim	Political Sciences	20 th March, 2004	Planning and Budget Implementation in the Health Sector
7 th	Abdulla Uba Adamu	Education	24 th April, 2004	SUNSET AT DAWN, DARKNESS AT NOON: Reconstructing the Mechanisms of Literacy in indigenous Communities
8 th	Auwalu Hamisu Yadudu	Private and Commercial Law	5 th June, 2004	LAW AS INTERPRETATION: An Exploratory inquiry from Islamic Law Jurisprudence

S/N	NAME	DEPT	DATE	TOPIC
9 th	Mohammed Sanni Abdulkadir	History	31 st July, 2004	STRUCTURING, STRUGGLING AND SURVIVING ECONOMIC DEPRESSION IN NORTHERN NIGERIA: The 1930s As Preview of the present
10 th	Muhammad Sani Sule	Bio-chemistry	23 rd March, 2013	Enzymology and Radiation Biology in the Understanding of Biochemistry
11 th	Essiet Unanaowo Essiet	Agriculture	22 nd May, 2013	AGRICULTURE SUSTAINABILITY IN THE DRYLAND OF NIGERIA: Realities and Prospects
12 th	Aliyu Kamal	English Studies	5 th March, 2014	The Islamic Novel Style and Structure
13 th	Abdu Ahmed Manga	Agriculture	9 th April, 2014	Horticulture as a Panacea for Food Insecurity and Unemployment
14 th	Sa'idu Muhammad Gusau	Nigerian Languages	26 th May, 2014	Wakar Baka Bahaushiya (The Hausa Oral Songs)
15 th	Abdulla Uba Adamu	Mass Comm-unication	9 th July, 2014	IMPERIALISM FROM BELOW: Media Contra-Flows and Emergence of Metro-Sexual Hausa Visual Culture

S/N	NAME	DEPT	DATE	TOPIC
16 th	Ghaji Abubakar Badawi	Library and Information Sciences	29 th July, 2015	THE ROLE OF PUBLIC LIBRARIES AS CENTERS OF INFORMATION TO DISADVANTAGED GROUPS: A 2004 - 2014 Study of the Information Needs of Gada Prostitutes in Dawakin Kudu Local Government Area of Kano State, Nigeria.
17 th	Mohammed Kabir	Community Medicine	16 th September, 2015	Public Health Concern for Chronic Non-Communicable Diseases Surpasses Anxiety Over Most Infections
18 th	T.I. Oyeyi	Biological Sciences	30 th March 2017	Linking Schistosomiasis and Water Resources Development in Kano State Nigeria: Public Health Impact and Mitigation
19 th	Abdulrazaq G. Habib	Medicine	27 th April, 2017	Medicine, Science and Society – The Global Health Imperative
20 th	S. Y. Mudi	Chemistry	6 th July, 2017	Natural Products: Plants as Potential Sources of Drugs
21 st	Sani Ibrahim	Biological Sciences	27 th July, 2017	BETWEEN LIFE AND DEATH: Water Quality and Resource Evaluation - The Place of Hydrobiologists
22 nd	J. Afolabi Falola	Geography	26 th October, 2017	The Poor We Have With Us Always

S/N	NAME	DEPT	DATE	TOPIC
23 rd	Umar G. Danbatta	Electrical Engineering	2 nd November, 2017	GETTING OUT OF THE WOODS: Diversifying Nigeria's Economy Through the Telecommunications Sector
24 th	Adelani W. Tijani	Nursing	23 rd November, 2017	Wholesome Alimentation: Path to Radiant Health
25 th	Juwayriya Badamasiuy	Private and Commercial Law	21 st December, 2017	Uncovering Patriarchy in the Law: Feminist Movement for Re-Interpretation of Islamic Law in Focus.
26 th	Isa Mukhtar	Nigerian Language	25 th January, 2018	STYLISTIC THEORIES AND THE LINGUISTICS OF HAUSA PROSE TEXTS: the (SFL) approach.
27 th	Ganiyu Sokunbi	Physiotherapy	29 th March, 2018	TODAY IT HURTS, TOMORROW IT WORKS: Complimentary and Alternative Therapy for Failed Back Syndrome
28 th	Aminu K. Kurfi	Business Admin. and Entrepreneurship	19 th April, 2018	Micro-finance as an Elixir for Poverty Alleviation and Wealth Creation in Nigeria
29 th	Muhammad S. Khamisu	Arabic	17 th May, 2018	Substitution in Arabic Languages Rules and Types
30 th	Habu Nuhu Aliyu	Pure and Industrial Chemistry	21 st June, 2018	SCHIFF BASES AND THEIR TRANSITION METAL COMPLEXES: The Drug for the Next Generation
31 st	Hashim M. Alhassan	Civil Engineering	19 th July, 2018	EASING THE BURDEN OF TRAVEL: Can Roadway Capacity Modeling Help?
32 nd	Habu Mohammed	Political Science	13 th September, 2018	TUG OF WAR OR ECHO IN THE DARK? Civil Society Organizations (CSOs) and the Fight Against Corruption in the Era of Change Mantra in Nigeria

S/N	NAME	DEPT	DATE	TOPIC
33 rd	Bello Idrith Tijjani	Physics	20 th September, 2018	NAVIGATING THE DATA LABYRINTH: Application of Some Advanced Statistical Analysis in Atmospheric Physics
34 th	Mohammed Ajiya	Electrical Engineering	18 th October, 2018	SEAMLESS GLOBAL CONNECTIVITY AT THE SPEED OF LIGHT: Converting Intrinsic Phenomena in Optical Fibers to Capacity Increase.
35 th	Abdulrahman Abdul Audu	Pure and Industrial Chemistry	25 th October, 2018	MY ACADEMIC VOYAGE IN WATER INTO THE WORLD OF HEAVY METALS
36 th	Ibrahim Rakson Muhammad	Animal Science	21 st February, 2019	FORAGE AND FODDER PRODUCTION IN NIGERIA: Its Sensitivity in Sustainable Ranching.
37 th	Muhammad Bashir Ibrahim	Department of Pure and Industrial Chemistry	14 th March, 2019	WATER POLLUTION AND THE QUEST FOR ITS REMEDIATION: The Natural Resource Option
38 th	Oyerinde O. Oyeseun	Department of Physical and Health Education,	4 th April, 2019	MAN DOES NOT DIE BUT KILLS HIMSELF: The Dilemma of the Health Educator and the Moderating Influence of Health Education
39 th	Danladi Ibrahim Musa	Department of Physical and Health Education	25 th April, 2019	WAGING WAR ON THE DEADLY QUARTET AND ITS COMORBIDITIES: A Physical Activity Panacea
40 th	Kabiru Isa Dandago	Department of Accounting	2 nd May, 2019	THE ACCOUNTING IN HUMANITY KNOWS NO BOUNDS
41 st	Mustapha Hassan Bichi	Department of Civil Engineering	20 th June, 2019	MAN, ENVIRONMENT AND WATER - The <i>Moringa oleifera</i> (Zogale) Intervention

S/N	NAME	DEPT	DATE	TOPIC
42 nd	Mustapha Muktar	<i>Department of Economics</i>	27 th June, 2019	PEOPLE, PLANET AND PROFIT: Peaceful Bed Fellows at the Best of Times But Strange Roommates at Present - The Economist's Approach to a Peaceful and Sustainable Co-Existence